COMPUTE! Interviews Wendy Carlos And Frank Zappa

COMPUTE!

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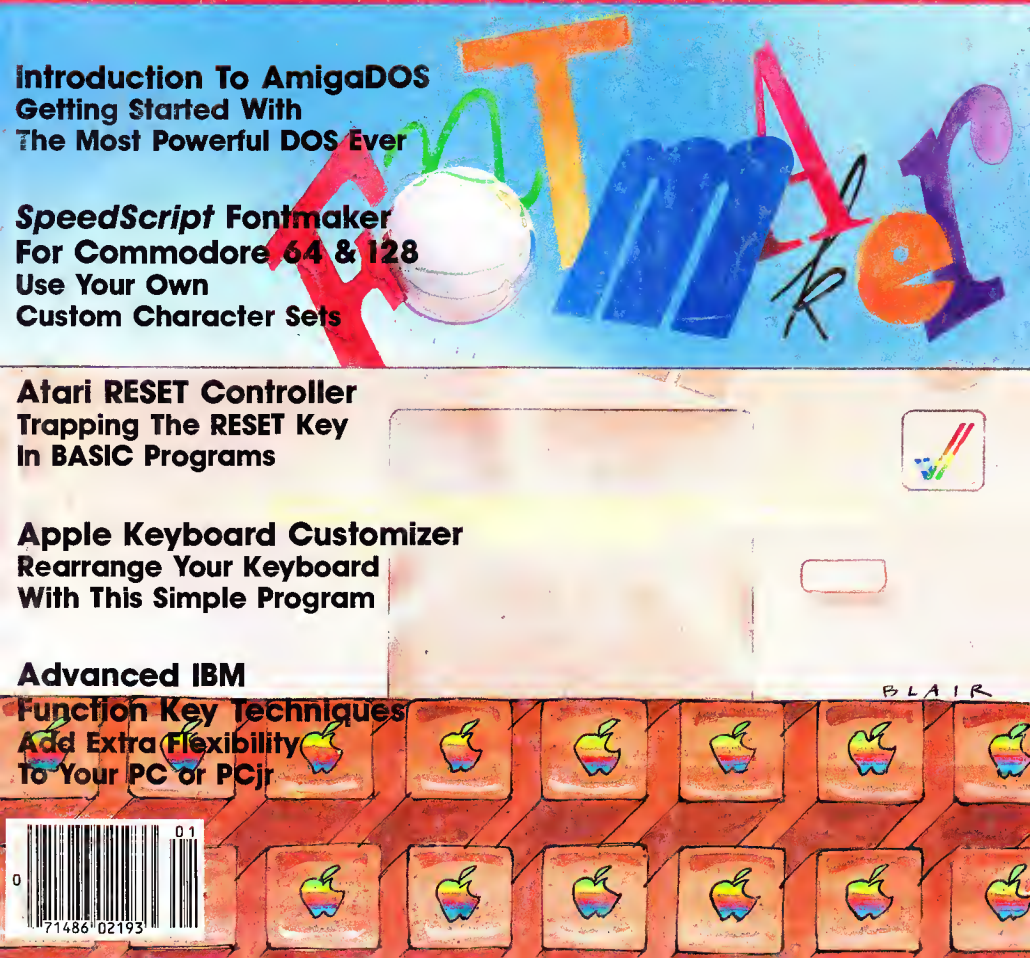

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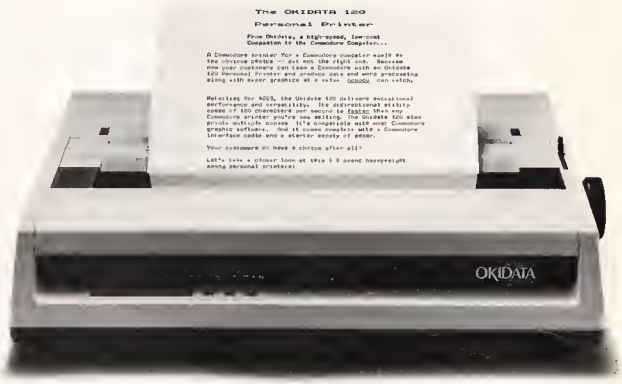

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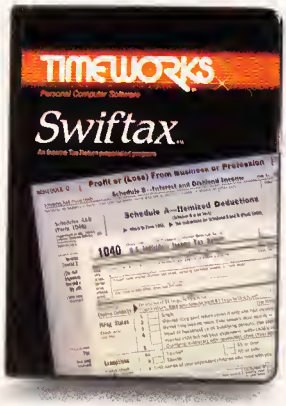

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JANUARY 1986
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ISSUE 68

GUIDE TO ARTICLES AND PROGRAMS

FEATURES

REVIEWS

COLUMNS AND DEPARTMENTS

THE JOURNAL

NOTE: See page 120 before typing in programs.

AP Apple, **Mac** Macintosh, **AT** Atari, **ST,** Atari ST, **V** VIC-20, **64** Commodore 64, **+4** Commodore Plus/4, **16** Commodore 16, **128** Commodore 128, **P** PET/CBM, **TI** Texas Instruments, **PC** IBM PC, **PCjr** IBM PCjr, **AM** Amiga, *General interest.

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Editor's Notes

This represents the first time in the history of our publications that we're printing the same set of "Editor's Notes" in both COMPUTE! and in COMPUTE!'s GAZETTE. The reason for this change of heart is a rather massive set of announcements—at least massive to me. In the space of two weeks, we've learned that two of our major competitors have chosen to close up shop. *Creative Computing* magazine and *Popular Computing* magazine are both reportedly ceasing publication with their December 1985 issues. To understand the significance of news such as this, you have to be aware of a bit of the history and folklore of our industry. COMPUTE! was first published as a fall 1979 quarterly issue. At that time, the largest, most successful publications in the industry were *BYTE* magazine, *Creative Computing, Interface Age, Kilobaud Microcomputing,* and *Personal Computing. Popular* didn't come along until the fall of 1980. I remember my determination to someday catch up with *Creative Computing* magazine in circulation. But before we could pursue 100,000 or even 50,000, we had to pursue 5,000, and it took many months for us to achieve that goal.

I remember too the twinge of jealousy I felt when McGraw-Hill, then owner of *BYTE* and publisher of the new *Popular Computing,* announced in a flurry all of the many expenditures being made in the launch of their newest magazine. I was even approached about the position of editor-in-chief with a promise of funds and staffing and the many things not so readily available to us at COMPUTE! without a McGraw-Hill behind us.

Creative Computing, under David Ahl's leadership, was at one time the premier magazine of consumer computing. Time and changes in the market eventually led to David's decision to sell to Ziff-Davis Publishing. Again, time and changes in the market have led to their apparent decision to close up the magazine.

Popular never seemed to establish its market niche with the clarity once demonstrated by *Creative.* It was always a junior introductory magazine that never seemed to bridge the gap between first time buyer and *BYTE,* its very successful parent. Perhaps *Popular* is the best example of that portion of our industry that came to rely on a massive influx of new computer buyers for growth. When, seemingly suddenly, our market dropped from 300 percent growth per year to 20 percent, the bottom fell out for many.

I applaud the immeasurable contribution to the personal computing industry made by *Creative Computing* and its founder David Ahl. I regret the demise of *Creative* and the demise of *Popular* as well even though it doesn't represent the same loss of industry-impacting personality that *Creative* does.

This is a rather significant time, both for my own personal reflection of what we here at COMPUTE!/ABC Publishing have accomplished, and on times past. We will assure you here and now that COMPUTE! Publications is and continues to be quite successful, quite proud of our place in the market, and quite determined to continue to provide you, our readership, with all of the many services that have enabled us to grow and flourish, even during these particularly difficult times for the industry.

Robert C. Lock

Editor In Chief/Founder

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• Inertial Navigation	Yes	Yes	No
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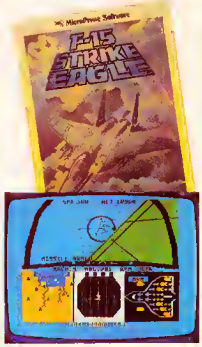

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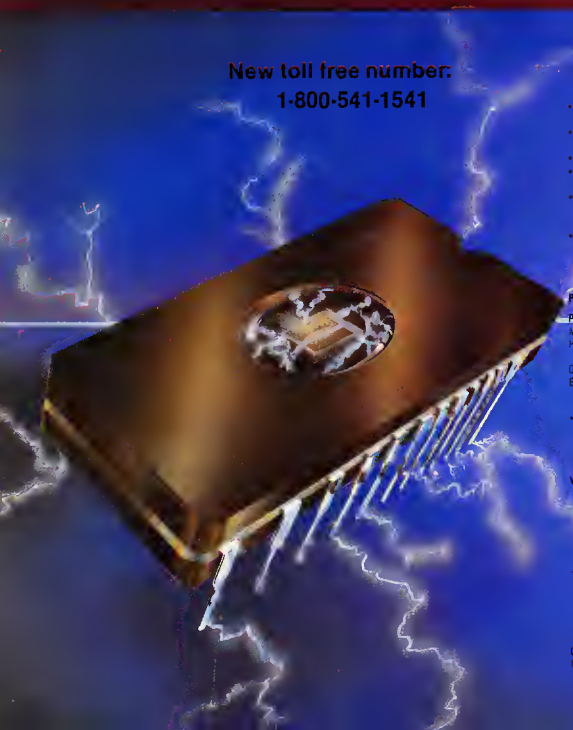

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PROGRAM	STAR DOS	REGULAR LOAD	MACH 5	FAST LOAD	MAGNUM LOAD
Pirstop II (EPYX)	?	144 sec	43 sec	41 sec	31 sec
Music Shop (BRODERBUND)	?	105 sec	105 sec*	105 sec*	21 sec
Hitchhiker's Guide to the Galaxy (INFOCOM)	?	70 sec	70 sec*	**	68 sec*
On-field Football (GAMESTAR)	?	159 sec	66 sec	63 sec	56 sec
EASY FINANCE I (COMMODORE)	?	58 sec	13 sec	13 sec	11 sec

* = Will not fast load — defaulted back to regular load.
** = *Failed to load at all.*

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MAGNUM LOAD created by Jim Drew

Readers Feedback

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If you have any questions, comments, or suggestions you would like to see addressed in this column, write to "Readers' Feedback," COMPUTE!, P.O. Box 5406, Greensboro, NC 27403. Due to the volume of mail we receive, we regret that we cannot provide personal answers to technical questions.

Hidden 520ST Operating System

In a recent article for COMPUTE! ["Atari 520ST: A Hands-On Report," October 1985], you mentioned a way to break out of TOS (Tramiel Operating System) and get into CP/M-68K on the Atari 520ST. As a new dealer for this machine, we would very much like to know how to do this, since the documentation we have does not explain it.

Michael Couch
Campus Computers
Brentwood, TN

Our article was ambiguous on this point, but apparently the Atari 520ST sold to the general public offers no direct way to enter CP/M-68K. We did it with a program file called COMMAND.PRG, which comes on one of the disks sold by Atari to software developers. When you execute this file by double-clicking its icon or directory entry, the GEM desktop disappears and is replaced by the prompt {A} (similar to the A> prompt in PC-DOS/MS-DOS or the D1: prompt in OS/A+ and DOS XL). To call up a directory from disk drive A, you simply type the command DIR. Typing B: changes the prompt to {B} for drive B. CP/M-68K offers many other DOS commands, including Unix-like commands such as LS (a synonym for DIR). The EXIT command puts you back in the GEM desktop and returns control to the mouse.

Actually, you aren't breaking out of TOS when you enter CP/M-68K on the 520ST—you're merely peeling away the GEM desktop environment with its icons, drop-down menus, screen windows, and mouse-controlled pointer. GEM, which stands for Graphics Environment Manager, is simply a layer atop CP/M-68K and TOS which makes the computer easier to learn and use. TOS is always present, hidden beneath GEM.

The COMMAND.PRG file isn't included on the TOS system disk supplied with the standard Atari 520ST. However, it's not a particularly long program: Someone familiar with 520ST systems programming could probably write an equivalent routine without much difficulty. If you can get a copy of COMMAND.PRG, the best way to enter CP/M-68K is to install the program as a TOS application, rather than use it as a GEM application. This ensures that the keyboard cursor stays on the screen while you're working with CP/M-68K. To install COMMAND.PRG as a TOS application from GEM, click once on the COMMAND.PRG icon or directory entry, then drop down the Options menu, select Install Application, click once on the TOS box, then click once on the OK box. You can make the installation permanent by saving the GEM desktop onto your TOS startup disk.

Fixing A Nagging Question

Each time you save a document with Commodore 64 *SpeedScript*, it asks DISK OR TAPE?. By now I have told the program several thousand times that I want to save to disk, not tape. How can I change the program so I won't have to answer that question?

Mark Smith

This is a simple modification. Coincidentally, someone else has contributed the answer. Our thanks to reader Eugene McMurray for sending these changes:

SpeedScript for the Commodore 64 is a great word processor, but few people use it with both tape and disk. Only three POKEs are needed to customize *SpeedScript* so that it always uses one device or the other. The change applies both to saving and loading. Load *SpeedScript* into memory, then type in the appropriate line in direct mode (without a line number) and press RETURN. *Be very careful when you enter this line.* Even a minor typing mistake will probably scramble that copy of *SpeedScript* in memory (if you mistype the line, reload *SpeedScript* and repeat the process).

SpeedScript 2.0 with disk:

```
POKE 4490,234:POKE 4491,169:POKE
4492,68
```

SpeedScript 2.0 with tape:

```
POKE 4490,234:POKE 4491,169:POKE
4492,84
```

SpeedScript 3.0 or *3.1* with disk:

```
POKE 4904,234:POKE 4095,169:POKE
4906,68
```

SpeedScript 3.0 or *3.1* with tape:

```
POKE 4904,234:POKE 4905,169:POKE
4906,84
```

Now resave *SpeedScript* with a different filename to distinguish it from the original. The program no longer prints the usual DISK OR TAPE? prompt before saving or loading a document..

Eugene McMurray

Son Of Immortal PC Programs

I was particularly interested to read "Immortal PC Programs" in the October 1985 "Readers' Feedback" column, since I have a different sort of undeletable file. Nearly a year ago, when I first got my PCjr, I saved a BASIC program under the name "TIC TAC" and have been trying unsuccessfully to erase it ever since. Much to my surprise, I find that a program with a space in the name can be SAVEd or LOADed, but not ERASEd, KILLed or DELETEd. How can I get my computer to erase the file, and why does IBM BASIC let you create files that can never be removed?

Richard Scarbrough

Several readers have raised the same question about this glitch in the IBM PC/PCjr operating system. There is a simple solution: Replace every space with a question mark wildcard symbol when specifying the stubborn filename. For example, KILL "TIC?TAC" from BASIC erases "TIC TAC" from the disk. One note of caution: Since the wildcard symbol replaces any character in the same position within that filename, this command would also delete similarly named files like TICATAC or TICOTAC. Save such files to another disk before deleting the unwanted file.

Apple DOS File Types

Recently I came across a file in an Apple DOS 3.3 catalog with a file type of S. What type of file is this and how do I edit it?

Joe Carlin

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There are only four official file types in DOS 3.3: T for text files, I for Integer BASIC, A for Applesoft BASIC, and B for binary files. However, a file's directory entry on the disk can indicate eight different file types, and some programs use one of these unofficial types. The most common example is the R type, which some assembler programs use to indicate a relocatable object code file.

Track 17 of an Apple DOS 3.3 disk contains the disk directory. Each directory sector contains a file's name, its location on the disk, and a byte that indicates the file's type. The highest bit (128) of the file type byte denotes a locked file. When this bit is set to 1, an asterisk is displayed next to that file's type when you CATALOG the disk, meaning you can read the file but cannot delete or modify it. The lower seven bits contain the file type. If all seven bits contain zero, the file type is text. If only the lowest bit is set, the file contains an Integer BASIC program. Here is what the various bit values signify:

Note that although A (Applesoft) and B (binary) appear twice in this table, only the bit values 2 and 4 represent usable file types. Values of 32 and 64 represent completely different files (if there's any use for these files, we've never seen it). The system pays attention only to the first set bit it encounters, scanning from left to right in the table shown here. For instance, the values 4 and 5 both indicate a binary file, since the first set bit occurs in the third lowest bit.

The simplest way to edit a nonstandard file is to find the program that made it and run that program. If that's not possible, you can use a disk editor like "Dr. Disk" (see COMPUTE!*'s* Apple Applications, *Fall/Winter 1985 issue) to edit the file directly or change its type byte (making the file into something that's easier to handle). For example, if you change a file to the text type, you may be able to handle it with an ordinary text editor. File entries begin in sector 15 of track 15 and build downward. The type byte is located one byte before the filename.*

Bit Pattern	Value	Type	Meaning
L0000000	0/128	T	text file
L0000001	1/129	I	Integer BASIC
L0000010	2/130	A	Applesoft BASIC
L0000100	4/132	B	binary file
L0001000	8/136	S	unused type
L0010000	16/144	R	unused type
L0100000	32/160	A	not Applesoft
L1000000	64/192	B	not binary

Atari Program Overlays

I'm programming a trivia game on my Atari 800. I was wondering if I could use the ENTER"D:" command to merge the questions for different categories into the program. The questions are stored in additional program lines on disk. My problem is that I can't get the main program to continue running after it enters the new question lines. Is there any way to keep the program running after it does an ENTER"D:" command?

David Rivera

Yes. In fact, there are several ways. What you're really asking is how to load overlays—new program lines that merge into memory under program control. By loading overlays, a program can, in effect, "rewrite" itself as it runs. This powerful technique is useful for a wide variety of tasks.

The simplest way to prepare an overlay is to append an appropriate direct-mode command onto the file containing the new lines you want to load. This is most easily done with a word processor or text editor that handles ASCII files, since the new lines must be stored in ASCII format with the LIST command to work with ENTER, anyway. Almost all word processors for Atari computers handle ASCII text, including AtariWriter, PaperClip, The Writer's Tool, Text Wizard, *and* COMPUTE!*'s* SpeedScript.

Follow these steps: In BASIC, type in or load the program lines that you want to merge with the main program. Store the lines on disk or tape in ASCII format with the LIST command, not SAVE or CSAVE. Load the file into your word processor or text editor. Move to the end of the file and add whatever direct-mode command you want the computer to perform after ENTER is executed. Typically, this command is either a GOTO to some other line in your program, or a RETURN if the overlay-loading routine is called with a GOSUB. You must type this command as a direct-mode statement without a line number. Be sure the command ends with a RETURN keypress. Then save the file back to disk or tape. The overlay is now complete.

When your main program loads this overlay with ENTER, the new lines are merged into memory and become part of the main program. (Remember that the new lines will replace any existing lines that have the same line numbers.) After the computer loads the last program line of the overlay, it executes the direct-mode command you tacked on with the word processor. If you don't have a word processor, you can add the direct-mode command by using OPEN with the append option—see your BASIC manual.

Another method of loading overlays is to use the dynamic keyboard *technique. This involves printing one or more direct-mode commands on the screen, positioning the cursor over the commands, and then activating the Atari's* forced-read mode *by POKEing 13 into memory location 842. To see an example, LIST these lines to disk or tape as your overlay (use the filename OVERLAY.LST for disk):*

```
100 PRINT "NEW LINE 100..
    .."
200 PRINT "NEW LINE 200..
    .."
300 PRINT "NEW LINE 300..
    .."
400 PRINT "NEW LINE 400..
    .."
500 PRINT "NEW LINE 500..
    .."
```

Type NEW, then enter these lines as the main program (replace the D: in line 30 with C: if you're using cassette):

```
10 GRAPHICS 0
20 POSITION 2,4
30 PRINT "ENTER";CHR$(34)
   ;"D:OVERLAY.LST"
40 POSITION 2,4
50 PRINT "CONT"
60 POSITION 2,0
70 POKE 842,13
80 STOP
90 POKE 842,12
99 PRINT "PROGRAM CONTINU
   ES HERE"
```

When you type RUN, you'll see the main program load the overlay and continue running. In effect, the POKE in line 70 makes the computer press its own RETURN key over the commands printed on the screen. The POKE in line 90 turns off this mode so the program can continue normally. If you want to blank the screen for cosmetic purposes while this program is working, add these lines:

```
25 POKE 559,0
95 GRAPHICS 0
```

By experimenting, you can add this routine to your own programs. The dynamic keyboard technique can execute virtually any command under program control in this manner.

PLUG For The Plus/4

Commodore Plus/4 owners now have a national user group, called PLUG (Plus/4 Users' Group). Membership costs $20 annually and entitles you to receive the PLUG newsletter, printed eight times a year. The newsletter contains programming tips, Plus/4 product reviews, reader mail, and other information such as a list of bulletin boards that support the Plus/4. Software-hungry PLUG members may obtain

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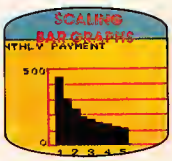

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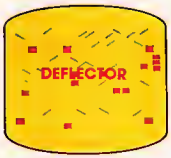

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Thanks for the information. Plus/4 users should also note that the Programmer's Reference Guide for the Commodore Plus/4 *will soon become available. Though we haven't seen a copy at the time of this writing, the publisher (Scott, Foresman & Co.) has scheduled the book for release in late 1985 or early 1986, with a projected list price of $19.95.*

TI-99/4A Subprograms

What advantage, if any, does a TI Extended BASIC subprogram (with SUB) have over an ordinary subroutine called with GOSUB?

Dan Schwarz

An Extended BASIC subprogram is quite similar to a subroutine. Both contain a series of BASIC statements set apart from the main program and are often used to perform a repetitive function. However, while a routine accessed with GOSUB may appear anywhere in the program, a subprogram must appear at the end. Subprograms are also called by name rather than by line number. For instance, the following statement calls a subprogram named MULT:

```
10 CALL MULT(A,B,C)
```

Inside the parentheses is the parameter list *or set of variable values you want to pass from the main program to the subprogram. This is necessary because the system treats the subprogram as a separate program: The subprogram can't recognize any variables used in the main program unless you pass their values in the parameter list. Here's how the subprogram MULT would begin:*

```
500 SUB MULT(D,E,F)
```

The SUB statement marks this as a subprogram. Since MULT expects to receive three variables from the main program, its parameter list contains three items. Parameters are passed according to their position within the parameter list: That is, the first parameter in the subprogram's list becomes equal to the first one in the calling list. In this case, D equals A, E equals B, and F equals C. You can use any simple variable names, of course. All subprogram variables are local, *meaning they have no effect on the main program. In this case, you can use D, E, and F in the subprogram any way you like without affecting main program variables of the same name.*

The end of a subprogram is marked with this statement:

```
580 SUBEND
```

One reason to use subprograms is that the computer can find them much faster than ordinary subroutines. During the prescan *phase of program execution, the computer looks at the entire program text, noting (among other things) the location of any subprograms. When the subprogram is CALLed, the computer already knows its location and begins executing its statements without delay. To locate an ordinary subroutine, on the other hand, the computer must scan the entire program for the right line number, which takes significantly longer.*

Because subprograms are called by name rather than line number, their placement in the main program is not dependent on line numbers. This feature, plus the use of local variables, means you can build up a library of program modules. Whenever you need one of the subprograms, you can easily merge it into the program you're working on. Since subprograms are always placed at the end of the main code, the program tends to be more structured and easier to understand. Similar features are common in more structured programming languages.

Resetting The 1541 Drive

Please publish a reset circuit I can add to my 1541 disk drive. I understand that resetting the drive by turning the power off and on is not particularly good for it.

Robert Desko

As with computers, there are two ways to reset the 1541 disk drive. A hardware reset is triggered physically (grounding the microprocessor's RESET line). A software reset is activated by a command that makes the device perform its normal powerup routines without actually switching the power off and on. Software resets save a little stress on the chips. For instance, SYS 64738 on the Commodore 64 has much the same effect as turning the power on. The equivalent command for the 1541 is UJ, as shown in this program:

```
10 OPEN 15,8,15
20 GOSUB 70
30 PRINT#15,"UJ"
40 FOR J=1 TO 1000:NEXT
50 GOSUB 70
60 CLOSE 15:END
70 INPUT#15, ER, ER$, TR, SE
80 PRINT ER;ER$;TR;SE
90 RETURN
```

This program displays the drive status twice, before and after the drive is reset. Here's what you'll see on the screen:

```
0 OK 0 0
73 CBM DOS V2.6 1541 0 0
```

*The first message indicates normal (no error) status. Though it's transmitted like an error message, the second message doesn't indicate an error. It's a "signature" which the drive generates every time you turn it on (like the 64's familiar powerup message *** COMMODORE 64 BASIC V2 ***). Once the command channel is open (line 10), you can reset the drive at any time by sending the characters UJ with a PRINT# command (line 30). You may replace the J in UJ with a colon, although there's no practical advantage in doing so.*

The delay loop in line 40 is needed because it takes the drive a moment or two to clear its internal memory buffers, set zero page variables, and complete other reset tasks. During that brief interval the drive can't respond to any other commands. To reset the drive from direct mode (when you're not running a program), type OPEN 15,8,15,"UJ" and press RETURN. Wait a second or two, then enter CLOSE 15 to close the command channel.

In most circumstances, a software reset is as effective as a hardware reset and has the advantage of resetting the drive without disturbing anything in the computer's memory. If you can't bring the drive back with UJ or by pressing RUN/STOP–RESTORE, you must do a hardware reset. Since the 1541 uses a 6502 microprocessor, building a reset switch is no more difficult than building one for the 64 or VIC-20. All you need is a momentary-contact, normally open switch wired between the 6502's reset line (RESET) and its ground line (GND). Since these lines are available on pins 6 (RESET) and 2 (GND) of the 6-pin DIN connector at the back of the drive, it's possible to make a switch that plugs directly into the serial port connector. Your disk drive manual contains a diagram of the pins. It's a good idea to debounce the switch by wiring a small capacitor in parallel with the switch terminals. Use extreme caution *when attempting this modification: If you don't understand exactly how to build the switch, get help from a friend who does or refer the work to a qualified technician.*

There's one disadvantage to performing a hardware reset. Since the serial cable connects to the RESET line in the computer's microprocessor, pressing a reset switch on the drive resets the computer as well—destroying any BASIC program in memory. Grounding RESET anywhere on the serial bus resets every serial device in the system. If you have a reset switch on your computer, an expansion card, etc., you'll rarely need a separate switch for the drive.

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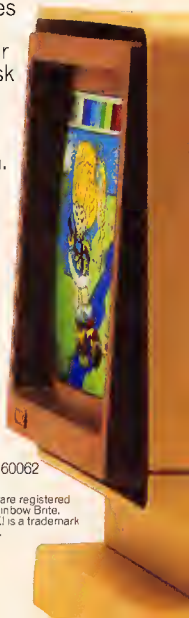

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TurboTape For 64 *SpeedScript*

People who use Commodore 64 *SpeedScript* [COMPUTE!, March 1985] and "TurboTape" (COMPUTE!, January 1985) might be glad to know there is a way to turbosave and turboload *SpeedScript* documents. This method is for use only with the latest versions of *SpeedScript* (3.0 or 3.1). First, create a new TurboTape program on tape for use with *SpeedScript*: Load and run TurboTape, choosing option two. Then enter NEW, followed by TURBOSAVE"RELOCATED TURBO" ,52606,53248. Once that's done, you can load and run *SpeedScript* and write your document. When you're ready to turbosave it, exit *SpeedScript* via the RESTORE key, then enter LOAD "RELOCATED TURBO" and press RETURN. Now enter the following statement as one line:

```
POKE768,126:POKE769,205:POKE678,139:
POKE679,227:POKE2498,96
```

Enter this statement:

```
TURBOSAVE"FILENAME",2049,52606
```

The process is complete. When you load the turbosaved document, you don't need to load and run *SpeedScript* first, because the turbosaved file includes *SpeedScript*. Just turn on the computer, load the file, and run it. This method steals about 400 bytes from the memory available for a *SpeedScript* document. If you frequently write documents that use up most of memory, you may want to make an additional modification to lower *SpeedScript*'s top-of-memory pointer. Load *SpeedScript* 3.0 or 3.1, enter POKE 2481,205 and resave the program.

Al Teter

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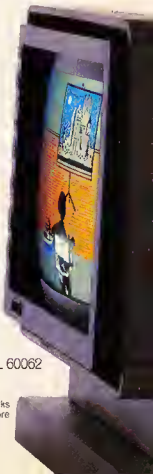

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At Lincoln Center, Tom Scott on saxophone plays a duet with an Amiga computer running a sophisticated MIDI-equipped music software program.

As the house lights at New York City's Lincoln Center dim, composer and jazz-rock musician Tom Scott blows a saxophone blast that wails through the auditorium. Moments later, Scott is joined by an Amiga computer running a program called *Harmony*, which plays a series of improvisational tracks that draws appreciative murmurs from the audience.

The Amiga was connected to an electronic keyboard and to Scott's saxophone through a link called the Musical Instrument Digital Interface (MIDI). Thanks to the *Harmony* software and MIDI, the Amiga was suddenly transformed into a powerful musical tool—part instrument, part performer.

The Lincoln Center concert was just one demonstration of the

MAKING MUSIC WITH MIDI

Selby Bateman, Features Editor

MIDI is a simple communications standard that lets you interconnect electronic keyboards, synthesizers, drum machines, sequencers, and personal computers. Adopted only a few years ago, MIDI has quickly become a genuine breakthrough that is changing the way musicians compose, play, and even think about music. Over the next few years, experts predict, MIDI will be increasingly spreading from recording studios and professionals into the hands of amateur musicians.

Amiga's capabilities at the computer's gala introduction to the press last summer. But it represented another milestone in the brief yet remarkable history of MIDI.

A new era in music began in 1982 when some of the electronic music industry's most respected companies—Yamaha, Korg, Roland, E-Mu Systems, Sequential Circuits, and others—reached an important decision during the National Association of Music Manufacturers (NAMM) convention. They agreed to establish a set of digital transmission standards for electronic music. During the following year, the idea became reality when the companies adopted a standard of technical specifications called MIDI.

Under the MIDI concept, electronic music devices which include MIDI circuitry can work together with other devices or instruments also equipped with MIDI. MIDI consists of a hardware standard for physically connecting musical devices, plus a software communications protocol that governs data transmission over the interfaces. It's doubtful that even the companies themselves realized at the time how swiftly and thoroughly this

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standardized hardware and software combo would alter the world of electronic music.

Without MIDI, consider the viewpoint of a musician or an instrument manufacturer. Suppose you want an electronic keyboard from Yamaha, but also would like to play a particular synthesizer built by Korg—and want to add the percussive sounds of a Sequential Circuits drum machine, too. How does one musician control all these instruments to take advantage of their features? That's a lot of hardware to use all at once, no matter how ambidextrous the musician.

MIDI-controlled musical devices, like this $1,395 digital sampling instrument from Ensoniq with a built-in 3½-inch disk drive, are bringing computers and electronic instruments closer together.

Could the instruments somehow be linked together and controlled from a master board? Before MIDI, the answer in most cases was no. And even if two of the instruments could be patched together, advanced features of both would be inaccessible. For professional musicians, the limitations were oppressive. For manufacturers, the incompatibilities meant lost sales.

MIDI was designed to solve those problems. Compatibility among instruments had arrived. But what quickly became obvious was that MIDI was also perfect for communicating with another breed of powerful creative tools—personal computers. Electronic musical devices and computers were a natural combination. With computers, the MIDI bandwagon really began to roll.

"More than anything else, MIDI is turning musical instruments into computer peripherals. And it's making it possible for a much larger group of people to make music," says David Kusek, president of Passport Designs, a computer music company that sells a variety of MIDI products. "MIDI is changing the nature of music learning and production."

A computer's advanced processing capabilities, when coordinated by the right MIDI software, let a musician control an orchestra of electronic instruments in ways that would have been impossible just a couple of years ago. Suddenly, the composing, editing, and playing features which previously cost tens of thousands of dollars are within the reach of amateur musicians and computer owners. A single musician can perform like an entire band. A composer can create works for a full orchestra, and then hear the results before another musician ever sees the composition.

There are already dozens of companies creating hundreds of products to take advantage of the MIDI standard. They range from MIDI-compatible interfaces and MIDI computer software to musical instruments with MIDI circuits and jacks for receiving and sending digital musical data.

It's relatively easy to understand the basics of how MIDI works. The best source for MIDI technical information is the International MIDI Association (IMA), a nonprofit organization made up of manufacturers, musicians, educators, and others interested in electronic music. IMA makes available the current MIDI 1.0 technical specifications. The 14-page MIDI specs and a 50-page detailed technical explanation of MIDI, written by the MIDI Manufacturers Association, are available together from IMA for $35 (or $30 for IMA members—see the accompanying "MIDI Buyer's Guide" for more information).

Although MIDI's effects can be quite sophisticated, the technical specifications are simple. First, MIDI is an open-ended system, based on a *minimum* set of standards. Manufacturers can go beyond the minimum specifications as long as they maintain MIDI compatibility.

There are three types of MIDI ports: MIDI IN for receiving data, MIDI OUT for sending data, and MIDI THRU for passing along data. The ports are common five-pin DIN female jacks, so they can be connected together with shielded audio cables ending in five-pin DIN male plugs.

For example, the rear panel of the Atari 520ST computer has MIDI IN and MIDI OUT ports that let the computer control any MIDI-equipped instrument, such as a keyboard, synthesizer, or rhythm machine. With help from the right software, the computer could capture the digital music data from a synthesizer and let you edit it, reverse it, change its key, modify the tempo, and even repeat the sound with the voice of a new instrument. The modified signals

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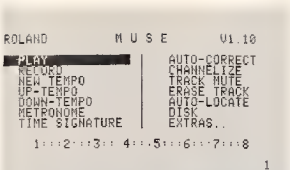
would be sent back to the synthesizer via the MIDI OUT port. The possibilities are limited only by the sophistication of the software and the memory available in the computer.

MIDI THRU ports, found on many electronic instruments, allow digital data to pass unchanged through the instrument to a third device. For instance, you could connect the Atari ST's MIDI OUT to a synthesizer's MIDI IN, and then link the synthesizer's MIDI THRU to a drum machine's MIDI IN. The synthesizer would pass the information sent from the ST to the drum machine without changing it. By selecting one data channel for the synthesizer and another for the drum machine, the ST could transmit separate instructions to both devices. This is possible because MIDI specs require 16 independent channels for receiving or transmitting data. The interfaces send data in asynchronous serial fashion at 31.25 kilobaud (roughly 31,250 bits per second) in a ten-bit code consisting of one start bit, eight data bits, and a stop bit.

For most purposes, though, you don't need much technical background to use MIDI. Setting up a MIDI interface between a computer and musical instruments is relatively easy. Connect the MIDI IN, OUT, and THRU ports, set the channels you'll be using, and your hardware system is just about complete. However, taking advantage of the power of this system and the computer programs which control it are entirely different matters. A musician who has trouble handling one instrument faces a greater challenge when given the opportunity to conduct the near-equivalent of an orchestra.

The range of MIDI-equipped musical instruments is wide, from high-end synthesizers, keyboards, and digital sampling devices costing thousands of dollars to some low-end keyboards below several hundred dollars and interfaces and programs under a hundred. MIDI is still in its infancy, but the amount of computer software



A command screen from RolandCorp's MUSE (MIDI Users Sequencer/ Editor) *for the Commodore 64 and Apple II-series computers.*

hitting the MIDI market is growing phenomenally, says Lachlan Westfall, director of the IMA.

"There are scads of products coming out. About a year ago, we published an article on one of the first MIDI programs to become commercially available. Now I'd say the number is close to hundreds."

Since connecting a MIDI network is about as easy as hooking up a home stereo system, manufacturers are starting to produce MIDI products that sell for lower prices, says Westfall. "For example, more and more synthesizers are not including internal sequencers. Why put a limited sequencer in a synthesizer when you can concentrate on a more sophisticated one that's a stand-alone sequencer? It just drives the price of the synthesizer up too much."

Increasingly, personal computers are being put to work as smart controllers for MIDI devices. Software and hardware interfaces have been developed for popular eight-bit computers such as the Commodore 64, Apple II series, and the Atari. (See the accompanying "MIDI Buyer's Guide.")

One recent example is RolandCorp's new *MUSE* (*MIDI Users Sequencer/Editor*), a $150 MIDI controller program for the Commodore 64 and Apple II series. *MUSE* has eight independent tracks for recording and overdubbing musical sequences, editing by measure, track-merging capabilities, autolocating, track muting, a chain mode for building longer tracks, looping, transposing, and MIDI channel reassignment. The system also features an autocorrect function that lets you correct rhythm errors in recorded sequences without affecting articulation or phrasing. *MUSE* can be synchronized with drum machines, other sequencers, and multitrack tape decks, and is compatible with all MIDI-equipped instruments. There's enough memory to enter about 6,000 notes.

Despite the power and sophistication of relatively inexpensive packages like *MUSE*, 64K computers do run out of memory if your composing and playing requirements are extensive.

"The big note number is about 6,000 on those [64K] machines," says Westfall. "You're hard-pressed to get a really complex song in there at once. If you use MIDI performance controls like a modulation wheel on a synthesizer or pressure sensitivity, that eats up significantly more memory than just playing notes. So, if you record a song and use some pressure sensitivity on your keyboard, and put some pitch bend in for expression, it eats up two or three times as much memory, and you can't even get a song [to fit in 64K]," he explains.

Westfall says he uses a similar program for the Macintosh which permits approximately 24,000 notes. "You can really do some stuff; I never run out of notes."

There's a growing amount of MIDI software under development for larger computers such as the Macintosh, Westfall notes. "A lot of people see that as a very good computer for a musician. And the new computers, the Atari 520ST and the Amiga from Commodore—I'm increasingly talking to more and more developers who are aiming in that direction."

The Amiga, especially, promises to bring personal computing into the world of digital music. The advanced computer has four low-noise digital voices, each with

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A Buyer's Guide To MIDI

MIDI-related products number in the hundreds now, and more arrive every day. The following list of vendors and products, although not meant to be comprehensive, should help you get started.

CZ Rider
Cherry Lane Technologies
110 Midland Avenue
P.O. Box 431
Port Chester, NY 10573
$150
Customizes Casio CZ synthesizer sounds with an Apple II-series computer and a MIDI instrument.

Dr. T's MIDI Sequencer Program
Dr. T's Music Software
24 Lexington Street
Watertown, MA 02172
$125
Software which controls MIDI instruments through the Commodore 64.

International MIDI Association
11857 Hartsook Street
North Hollywood, CA 91607
One-year membership (includes MIDI specs): $40.

MIDI/4
Passport Designs, Inc.
625 Miramontes Street
Half Moon Bay, CA 94019
$99
Four-channel MIDI software for Commodore 64 or Apple II-series (48K minimum) computers. Unlimited overdubs, realtime editing, transposition, external sync, tempo control.

MIDI/8 PLUS
Passport Designs, Inc.
$150
Eight-channel MIDI software for Commodore 64 or Apple II-series (48K minimum) computers.

MIDI Interface for Apple II and Commodore 64
Passport Designs, Inc.
$195
Allows use of MIDI instruments.

MIDI Processing Unit (MPU-401) and MIF-IPC Interface
RolandCorp
7200 Dominion Circle
Los Angeles, CA 90040
MPU, $200; MIF-IPC, $110
MIDI adapter and intelligent interface.

MIDI Interface for Commodore 64
Sequential Circuits
3051 N. First Street
San Jose, CA 95134
$99
Allows use of MIDI instruments.

MIDI Interface for 64
MIDI Sequencer for 64
MusicData, Inc.
8444 Wilshire Blvd.
Beverly Hills, CA 90211
Interface, $100; Sequencer, $150.
Interface and sequencer software.

MIDIMATE
Hybrid Arts
11920 W. Olympic Blvd.
Los Angeles, CA 90064
$200
MIDI interface for Atari 400/800, XL, XE.

MIDITRACK II
Hybrid Arts
$150
MIDI software for Atari 400/800, XL, XE with 16-track recording capability from keyboard. Editing commands, track commands, channel commands, sync commands. Requires 48K.

MIDITRACK III
Hybrid Arts
$374
MIDITRACK II with sequencing.

MUSE (MIDI Users Sequencer/Editor)
RolandCorp
$150
Software for Commodore 64 and Apple II-series computers, with eight independent tracks for recording and overdubbing, plus editing functions.

Music Processing System
RolandCorp
$495
MIDI software for IBM PC; built-in sequencer; generates scores; screen editing.

PC to MIDI Card
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MIDITRACK C
Hybrid Arts
$349
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Personal Composer
Mr. Jim Miller
14080 Edgewater Lane, NE
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Integrated software package for IBM PC for music scoring, 32-track MIDI recording, sequencing, and editing. Composing and editing possible via synthesizer or computer.

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51 Main Street
Yonkers, NY 10701
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Polywriter
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Software for Apple II-series computers; translates performances to sheet music; full-screen editing.

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independently programmable volume, level, and sound-sampling rates, plus stereo output. With an optional sound-sampling device, you can capture and store in memory any external sound. At press time, several MIDI software packages for the Amiga and 520ST were scheduled for release before the holidays. Manufacturers also are developing keyboards for the Amiga, ST, and Macintosh that will transform the computers into sophisticated musical synthesizers and sequencers.

One of the most interesting software packages is *Harmony* (recently renamed *Concert Craft*), one of several music programs being prepared for the Amiga by Cherry Lane Technologies of Port Chester, New York. The program, to be marketed by Commodore, can create musical accompaniment with either the Amiga's extensive built-in sound capabilities or stored sounds from MIDI instruments. The program follows the musician's tempo rather than forcing the musician to follow the machine's tempo. As several hundred people witnessed during the Tom Scott performance at Lincoln Center, the effects can be remarkable.

"There's a good and growing base of computer music programs," says David Sesnek, president of Sequential Circuits, one of the founders of the MIDI standard. "And MIDI has solidified to the point where we can pick up an instrument, walk over to a developer's instrument, plug it in, and it works. That's what standards are supposed to do."

MIDI already is having an extensive impact on professional musicians, and now it is emerging in the educational and home environments as well. During the next year, a growing wave of MIDI computer software and lower-priced keyboards, synthesizers, and other musical devices will become available. Because of this, Sesnek believes the biggest impact is yet to come.

"The real power is with the consumer," he says. "MIDI will allow the marginal musician perfect performances, if he's willing to use it." ©

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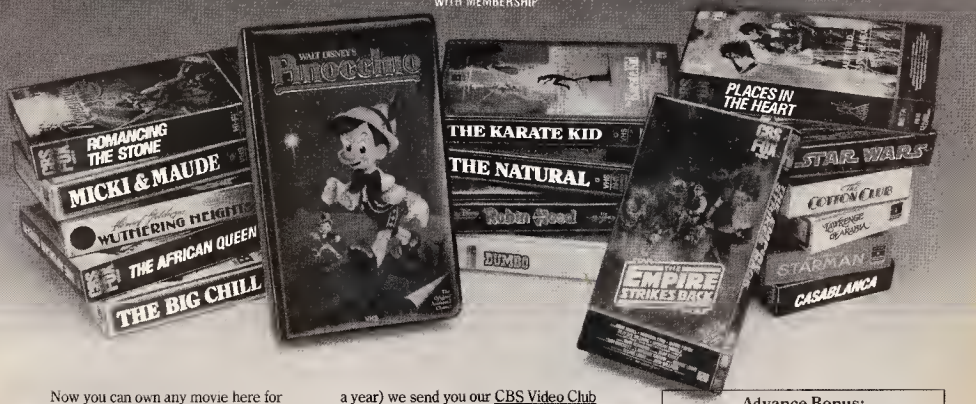

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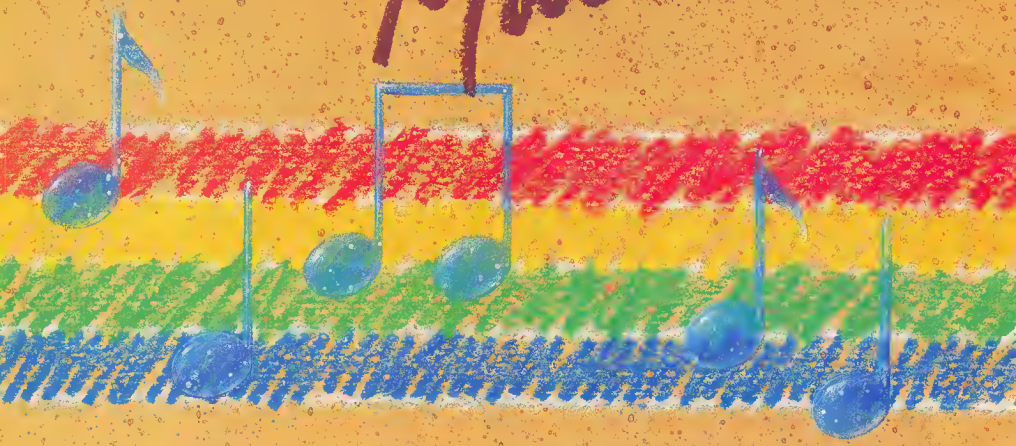
The Computerized Musician



Kathy Yakal
Assistant Features Editor

Sophisticated synthesizers, sequencers, digital sound samplers, and other computerized instruments of the electronic age are becoming more widely adopted by professional musicians than ever before. Thanks to personal computers, many of these devices are coming within reach of amateurs as well. To learn more about how these developments are affecting today's music and musicians, COMPUTE! talked to two innovative composers/performers who have spent years exploring the potential of electronic instruments.

COMPUTE! Interviews

A pioneer in electronic music, Wendy Carlos served as an adviser to Robert Moog in perfecting the Moog synthesizer. Using that tool, she developed electronic simulations of orchestral sounds and set an early standard for such realizations with her 1968 album, Switched-On Bach, *which became the largest-selling classical record of all time. Carlos' original music has been heard on such movie soundtracks as* A Clockwork Orange, The Shining, *and* Tron. *Her latest album was* Digital Moonscapes, *and she is now completing* Catalyst, *to be released in the spring of 1986.*

C!: Computers have simplified many tasks that used to be very time-consuming and difficult. Some people have drawn the same analogy with synthesizers and music performance and composition. How do you respond to that?

CARLOS: The more I get into the music field, the more difficult I realize it is, and the more amazed I am that the Beethovens and Bartoks accomplished so much in their

Wendy Carlos And Frank Zappa

lives, because it is so hard to write music and try to approach masterpiece status. The closer you get, the more you're in awe of how onerous that task is.

Please don't believe that because an artist makes something look easy that it's really easy. The practice doesn't go away because you have a fancy machine with a lot of bells and whistles on it.

Composition is that same kind of process. Sure, you can set up a song with eight bars followed by eight bars of the same followed by eight bars of something different and finally eight bars of repeating the first thing again. That kind of thing is done all the time. A lot of people who have wonderful words strum a guitar and play things they call songs. But there's a big difference between doing that and putting together Beethoven's Fifth Symphony or one of the Mozart operas. It's all the difference between writing an advertising slogan in English and Shakespearean plays in English—you use the same tools, but can't you see that there's a vast difference? Don't put your hopes on going out and becoming star of the day with some technical hardware.

But there certainly is a breakthrough. The period of time we're going through now is a time in which the first generation of computer-assisted music-making machines is taking place, and that's exciting.

C!: But it's been almost 20 years since the first synthesized music was created. Why do you still call it the first generation?

CARLOS: Ninety-five percent of the synthesizers on the market

today do exactly what we realized in 1968 was not quite good enough, but it was at least enough to get started in putting sounds together. That precedent was set by those of us who were working in the field, and it's lingered now for a good long while. Now you're at a time in the history of music when the stage of those instruments is starting to get phased out very gradually, very slowly, by the new computer generation of instruments which are only prototyped. Each company has its own approach on what to do, and there really is no standard as there was with the analog synthesizers.

I'm fed up and have been for a number of years with the analog synthesizers. I got very bored with them by the end of the first album, and I'm amazed that pop music is still using the same vocabulary, since there are so few sounds that are available in that kind of instrument. I don't know why people haven't said "Hey, I'm bored with this instrument." There's much more sound available in the guitar than there is in the average synthesizer.

All of the manufacturers like Bob Moog, when we all get together, we kind of frustratedly roll our eyes around. We'd like to see the market encourage that there be something different, but the market is extremely conservative about any change with this funny little machine that they think is something that must have come down with Moses. I'm hoping that they just finally get bored so we can start getting into what only a few instruments have now.

C!: What kind of music equipment do you use?

CARLOS: I'm fortunate to be able to work with a machine that's based on an instrument that Bell Labs developed. It's a digital synthesizer which is so open-ended that it allows you to make an awful lot of things that are foolish and silly, because it's such a good tool that it overlaps everything. They did not want to become trapped like so many companies in the past by saying "Oh, this is inaudible. Don't put it in. You're not going to need that ever, we'll cut that out too." They didn't do that. They left everything in. It's an elaborate, messy affair, but it allows you to come very close to what everyone else says they can do, and that is to make any sound you can conceive.

The truth is that even this instrument cannot make any sound imaginable, but it's a lot closer. The reason is it takes apart every sound into individual parts of sound, sine waves, harmonics, which you then have the option of moving around from millisecond to millisecond, amplitude and frequency, all of them, and there can be hundreds of them. It's like having an artist who is painting on a canvas with a very tiny paintbrush.

Wendy Carlos

C!: How would you compare your work with your synthesizer to what a conductor can do with a traditional orchestra?

CARLOS: One of Carlos' laws is anything you can control, you must control. If you make a machine that gives the pilot of a plane the ability to move every molecule on the surface of the plane, the pilot will probably crash the plane because there's too much there to control—it's overwhelming. Whereas if you have an automatic pilot with a lot of automatic features, the pilot has very little to do, and there's very little difference from one flight to another because it's almost automatic.

Somewhere in-between is where we stand with synthesizers. It's a machine that allows you to do just about everything, but it carries the burden that you have to do just about everything. You have to control all kinds of nuances that most musicians take for granted when they pick up a good violin or good trumpet or good french horn. They know the instrument will do certain things for them already. But if you had to build the instrument from scratch, starting from pouring some molten brass into a mold and figuring out what length you wanted to make it, then you'd have the possibility of making an entirely different kind of french horn, plus you'd have to spend a lot of time doing it.

So that's the other edge of the sword. If you have a good, powerful tool, it's extremely exciting and useful, but it's also going to require you to spend an awful lot of perspiration and time learning to use that tool. I think it always works that way in any field. Electronic instruments have now reached the stage of sophistication where they're like all of the other good tools in the world.

C!: Then what does that imply for the near future?

CARLOS: I'm within a couple of minutes of finishing an album that has been overwhelmingly time-consuming and exciting. It's the most exciting thing I've ever done in my life, and I don't usually indulge in that kind of hyperbole. Because of this technology, I can do music that is totally unlike anything that has existed, yet which is totally based on the shoulders of giants.

This machine has the ability to play any kind of timbre, even if it's orchestral or electronic sounding or anything in-between—and that's actually where you stay, is in-between—and any tuning, so you don't have to use the equal-tempered scale that all of the other synthesizers are locked into using.

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Which means you can use perfectly pure intervals that sound absolutely like clean air when you're used to breathing musty air, or like drinking pure, good water. It's not a huge thing. It's not going to knock you over like my infamous first record, which was so much filled with the novelty of new sounds that everyone with tin ears could even tell the difference. This stuff is a little subtler, but also remarkably more sophisticated. The music is available to use any way the intervals sound best to the ears, no matter what it looks like on paper. In the past, the equal-tempered scale made good numbers, but it didn't make good sound.

I'm talking about things that are not scientific and mathematical so much as they are plain, old-fashioned, sounding good. It's like cooking by taste rather than with a recipe. Instead of following the rules that someone else sets down, you taste along the way and say, "I think it needs a pinch more garlic," or whatever. You shape it as you go along to make it the most sensorily exciting thing it can be.

I feel—and I didn't think this would happen in my lifetime—it's probably the best way to get out of the abysmal mess that most modern music is in. We're in a situation in history where now we have tools to make anything imaginable, and yet we have all kinds of rules, with people telling us, "Pop music can only be in this kind of key. It has to be diatonic with a tempo of 4/4 or 6/8." Classical music is terribly abysmal because you have to write it very, very ugly—not a single triad, no harmony, no melody. And it goes on and on.

It's contradictory to me. We now have the ability to stand on 95 percent of a floor that we could never before stand on more than 50 percent of, and we have nothing but dogma around telling us we're not allowed to do that.

I suspect there are going to be an awful lot of uptight people who, when they hear my new work, are not going to understand it, or they're not going to want to understand it because it represents leaving the confines of what they do and facing the great unknown. Which is what art should always be about.

C!: It sounds like this album will have a very unusual sound. Will any of the instrument sounds be familiar to listeners?

CARLOS: The sounds are extrapolated from traditional sounds, like what would happen if we took the sound of a nice, rich Stradavaria and instead of playing it with a bow, make it sound like it was being played with a piano keyboard. Or if we made a marimba out of brass. Or if the timpani weren't percussive but a woodwind, and you played by blowing on it. They're going to sound like nonelectronic acoustic instruments that somebody must have built, because they just never existed before.

The trick—the thing that was the hardest—was to control this entire mass of what could be a very chaotic enterprise and pound it into a shape which I hope is going to be comprehensible by the people listening to it. It's taken every ounce of musicality that I have. I would love to have the musical geniuses of the past right here in the room with me to help shape it.

I'd like the album to tempt other people to try different things, to leave the safe American way of doing things, like trying to cook Japanese after eating sushi at a restaurant for the first time. Like shoes that you wear every day until they wear out because they're so comfortable, I think we've certainly worn out the musical system that we've been using since 1600s.

C!: Why do you think the norms haven't changed faster?

CARLOS: There's a perfectly simple reason. Habit. And the technology didn't permit you to do much different. Now the technology, without a whole lot of money, is there around the corner for any manufacturer who wants to bring it to the public. Or the public can yell about it so the manufacturers are forced to bring it to them, to make these possibilities available. Manufacturers, all the way up to the half-million-dollar Synclavier, have not done anything that is more than mini-minded.

My friends in the business are so depressed, because if you say "sampling machine," manufacturers' eyebrows shoot up. That's something good. But if you say "synthesizer," they don't want to hear about it. That's a sad situation. That's like saying, "We've got a cook here who's going to cook you a fine meal," and you say, "Nah, I don't want it. How about a TV dinner?" It's exactly at that level, but people don't see it yet. I would like people to be aware that they're going to have to ask for something a bit more ambitious than frozen concentrated food in their sound machines.

C!: How does your excitement about this new musical equipment compare to your feelings about the Moog synthesizer in 1968?

I am genuinely excited about this stuff. I can hardly go to sleep at night. It's like I have to get all of these things done before death happens. I feel a little silly in a way. Emotionally you're at the level of a child again. Something that's such a rich horizon of colors that you're giddy with delight, and you can't contain yourself because you want to get at them so much.

If I had had these tools back in 1968, I wouldn't have done *Switched-On Bach* because there would have been no need to do anyone else's music. There would have been no need to try and find ways of making these ugly sounds be a little bit musical. These sounds *are* musical. And they're already there to play. In 1968 I would have given my eyeteeth for this, and at the same time I would never have been able to predict anything like this was going to happen, except in science fiction.

C!: How do you think your musical training would be different if you were just starting out in the field today?

CARLOS: Using synthesizers, teachers can teach students things that I never was able to learn, which is how the sounds work, what makes them tick. They can take apart sounds to some extent, so if you have a drumstick tapping on a snare drum, you can see in which part of the sound the wood hits the metal, and then where the drumhead starts to let go, and then you can watch where it decays. There was no way to get at these

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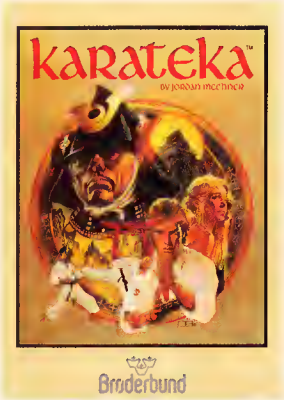

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things in the past, so you just read books. And the books were usually wrong because they didn't know, either. Whereas now you can really learn what makes sound tick while you're young, and go way past anything I'm able to do now.

So it's the best of times that I can see for music during the last 100 years, since the orchestra sort of got locked in, and since the instruments pretty much stopped changing. There's been a lot of sensationalism, but nothing of real substance. There's a marked change in what can be done right now that is as exciting as from Bach through Mozart into Beethoven, when the big orchestra started to get put together. And by the time of Wagner and Strauss and, of course, Papa Brahms, we finally were able to put together the most sublime of the acoustic instruments doing the most sublime things that people had trained themselves to perform.

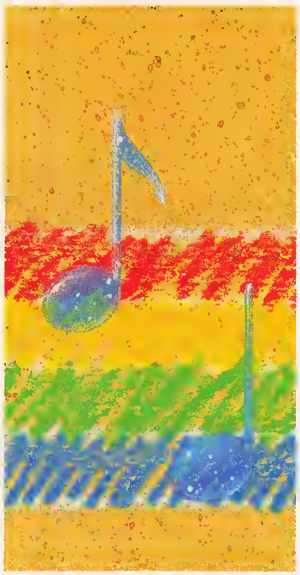
That has never been equalled by electronic devices in any fashion. It used to be painful to work in the electronic form because you were aware that you were giving up the richness of a traditional orchestra in order to work with a lot of simple-minded, ugly sounds, and it was a bad tradeoff. It's no longer a tradeoff.

C!: Is there still need for and value in learning traditional methods and instruments?

CARLOS: In producing this latest record, each time I tried to find a cheap, quick, and dirty way of doing something I knew how to do the hard way, I wasted so many months. It's larceny that always gets us in the end, anyway. If you don't look for the shortcut and you just do the job simply, it gets done.

You've got to know what chords are doing and how to shape a phrase, or your music is going to suffer. I think all of the knowledge you can get now that didn't exist a hundred years ago should be added to, not replaced—the kinds of musical savvy and things we've had up to now, like knowing how to play and harmonize and write and how to orchestrate. With the new sounds, you've got to know how to put sounds together. So orchestration is probably as important now as it's ever been—maybe more.

But added to that is this new insight into what makes sounds the way they are. You have to start by learning what makes the sounds of traditional instruments—not because you're going to do that for the rest of your life, but only because you're standing on the shoulders of



those giants. If you were an apprentice chef, you would learn to do all the traditional recipes before you went on and invented your own. That's the way I think it should be, and I don't think this is a preposterous, pompous, old stodgy idea at all. I think it's just a wise thing to do. Not to look for your own larceny, but to go for the simple path that's proven to work for anyone who's ever done anything of value in music. Do it while you're young if possible, and just enjoy the most exciting time that's ever been in music.

C!: Do you sense a certain level of panic on the part of acoustic musicians? Do they feel threatened that this new technology will make their talents obsolete?

CARLOS: Yes. A lot of people talk this way. Of course, they think they're unique, but they're not unique at all. In almost any field where there has been any kind of technology change, like in the British industrial revolution when people started making teacups out of a mold instead of on a wheel, the people who had done it by hand might have felt uptight in exactly the same way.

To some extent, they're actually right. The field has shifted, as I said, for the first time in a hundred years. To the extent that you do not keep up with the times, slowly your particular little niche is in a sense being replaced. If you already know a musical instrument well enough that you're really a fine musician—I assume that's what these people are talking about—you would be the best person to try and latch onto the new technology, because most of the younger people playing the instruments have no musicianship at all. A lot of them are very bad musicians. They don't know how to play, and they're letting the machine do the work for them and letting it hide the fact that they really don't know how to play. I think the older musicians, if they could get into the newer technology, could do it better.

The trick is you try to keep up with the times. There are a lot of drummers who are now doing drum machine programming, and they do it better than anyone else. Of course they do. How can that surprise anyone?

My own feeling is that they needn't worry, because it's going to happen so slowly. It could be 25 years before it becomes odd to see an acoustic group of instrumentalists on a stage. I don't think that's going to happen quickly at all. They'll live together comfortably for quite a few years. But the people who pay for these things will find out soon that something like two dozen people playing a new generation of instruments as based on the work of people like myself can do the same thing the orchestra can do. If they can use two dozen people instead of a hundred people, they're going to do it because it's cheaper.

C!: So you think that it's economics that will force a lot of the changes.

CARLOS: That's going to be the thing that does it in the end. It's what caused the earlier jobs to be

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replaced by technology. People tend to move toward where it costs less to do the same job. That's the real enemy, if there is an enemy here. If you want to blame anything, blame the larceny of people who look for less cost. Don't blame the poor synthesizer player. We're trying to open up the door for more possibilities, because that's what human beings have always done.

Though probably best known for his offbeat music in the 1960s and 1970s with the rock group The Mothers of Invention, Frank Zappa has produced a body of work that includes 39 albums, more than 200 vocal songs, 91 instrumentals, 32 compositions for orchestras and choral groups, four ballets, two feature films, and two video specials. His most recent album, The Perfect Stranger, *is a compilation of computer music and performances of his chamber works. Skeptical of traditional music education, Zappa learned his art by reading in public libraries, listening to records, and performing in different settings.*

C!: You used to write music that was impossible for human musicians to play. Can those pieces be played now by electronic means?

ZAPPA: Absolutely.

C!: How do you use synthesizers in your work?

ZAPPA: I use synthesizers for three things: for generating sounds that never existed before, for performing music which human beings would have difficulty playing, and to get rid of some of the drudgery of composition. In composition, you can copy phrases, which to do manually is real drudgerous. When you're doing repeats and things, a lot of that stuff on a computer is just push-button, like using a word processor.

C!: What equipment do you use?

ZAPPA: I use a Synclavier polyphonic sampling system, which costs about a quarter of a million dollars. Other things I'd like to use but haven't been able to afford are the 4X, which was developed in France at Ircam, and the new Fairlight system. But what I'm waiting for is a MIDI interface that will allow the Synclavier to talk to several other sophisticated devices. Buying all these new devices individually would be like starting all over again, like learning a new language, unless there was a MIDI interface that was reliable in letting them talk to each other.

C!: Is there much distinction musically these days between instrument sounds and synthesizers?

ZAPPA: My Synclavier uses samplings, digital recordings of real sounds, and allows you to manipulate them, so there is no difference

between the real instrument and the digital recording. As for how easily people can tell the difference, it depends on the composition. The stuff that I'm doing on an album that's not yet released, you wouldn't hear real instruments playing but would recognize the sounds of real instruments that humans would have real difficulty doing. Little things like really complex rhythmic patterns that are being played by whole ensembles of instruments in harmony.

C!: So how will this technology affect future training of musicians? Will it mean that less emphasis can be placed on theory?

ZAPPA: A lot of people have already skipped over music theory because all they're interested in doing is having a recording career, and all you need for a recording career is a good hairdo and some diagonal zippers. Music theory has nothing to do with that.

If you want to do real composition, my advice to anybody is to invent your own theory. Musical theory is an averaged-out series of regulations derived from common practices of an earlier era. When you get your theory books, they tell you "Don't do this" and "Don't do that" because in such and such a period they didn't do this and didn't do that, and that was the norm. You also have to remember that those norms were done to appease the tastes of the people who were paying the bill. That means the king, the church, or the dictator. There's no reason to assume that they had any better musical taste than you. So my advice is go out and make it up yourself, and don't worry about getting academically certified by an institution. No matter how pedigreed your technical approach to music, if you don't like the way it sounds and if somebody else doesn't like the way it sounds, then why did you bother to do it? You can be totally correct as per the book, but you could wind up writing really boring music.

C!: But hasn't a lot of that music been successful?

ZAPPA: There is a lot of really boring music that has been successful, but it wasn't generated by the means I just described. I can't think of anybody who did it all by the book and wound up either being a good composer or even a famous musician.

The other thing is that if a person wants to be a composer in America, I think he really ought to have his head examined before he goes into it, because nobody really wants to hear what you're writing. How many brand-new compositions have you ever heard? Compositions that were written in the last year or two, modern, up-to-date compositions by living composers, people who want to write music in America? There are people writing music, but it just doesn't get played.

The music business has nothing to do with being a composer. Composers are out of the music business. If you're talking about composition, it lives in academia and dies in academia. If you're talking about the music business, you're talking about the hair and the zippers.

C!: Then you think people in music schools are doing good composition work?

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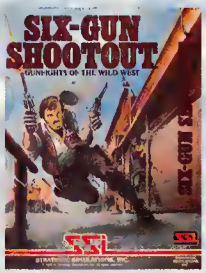

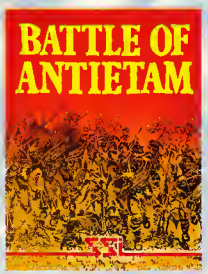

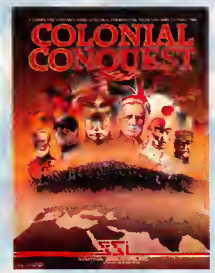

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ZAPPA: I have no way of knowing who's doing good stuff because, like I said, it doesn't get played. Most of the people who are getting grants, I really don't enjoy. The reason they're getting grants is because they're fashionable. Grants attract grants. People kind of nominate each other and keep it in the family. The same people get the awards and the same kind of drivel comes out. Then when the drivel comes out, the faculty, the composers-in-residence at the college, say to themselves, "Well, look, this guy got a grant and he wrote drivel, so I must teach drivel, and maybe if I teach drivel, then I will get a grant, and of course my students need to learn drivel so they can get grants."

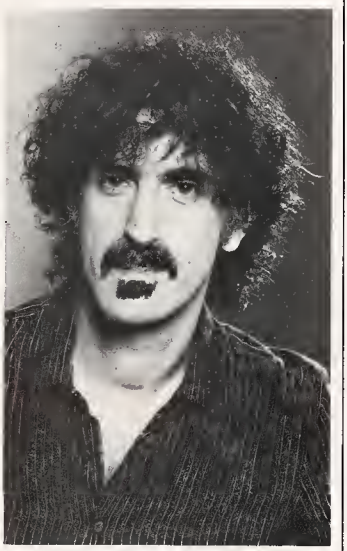
I've always had an argument with music schools, especially the ones which de-emphasize live performance. There are some conservatories which insist that the people who attend don't play gigs, which I think is foolish. It doesn't really train the musician or composer to make a living in the real world. They'd probably do better by these people to tell them to go out and get an Herbalife franchise or something like that.

C!: What about the argument that traditional musicians, people like conductors and instrumentalists and engineers, will become obsolete because of the new electronic technology?

ZAPPA: There's a lot to be said for doing away with some of those people anyway. First of all, I don't think recording engineers are ever going to be out of work. As far as conductors go, I don't have any genuine statistics on this, but I have the sense that most conductors, especially famous conductors, really aren't doing anybody any favors, because of the economics of the industry.

Let's look at the reality. When a person comes to a concert, he's coming to see a star conductor standing in front of an anonymous blob of musicians. What do those musicians play? Not any brand-new, interesting, exciting music. No. They can't. Because it costs too much money to rehearse a brand-new piece of music. They play everything they already know from when they went to conservatory. It's like a jukebox. A conductor basically has the function of a guy who waves his arms in front of a jukebox. Everybody in the orchestra already knows how to play Beethoven, and he knows how to conduct Beethoven. He walks in and does one rehearsal on the day he arrives. They know where it goes fast, where it goes slow, and it's a scam. The people who go to the concert are not there to hear music, they're there to see the guy waving his arms and swoon over it.

On the other hand, there are a handful of committed conductors who have an interest in bringing new music to life, but they're stymied by the fact that the costs of doing it are astronomical. That's one of the reasons why there is very little new orchestral music written—because you can't afford to rehearse it. Most composers working in an academic setting are working on small ensemble pieces of generally such an ugly nature that who can tell whether or not anyone played a wrong note? It's also easier to rehearse those pieces, and it costs less because there are fewer musicians.



Frank Zappa

The other factor is most of it doesn't get recorded anyway. The audience comes to a concert of new music. They get to hear the piece played one time, and if the performance is no good, they're not doing the composer any favors, either. The audience listens to it and has no idea what the composer wrote. They just get to hear the net result of all the choreography and politics that goes into those concerts.

So if the real concern is music being played accurately and being true to the composer's wishes, the computer is the thing that's going to allow that to happen. At that point, the composer gets to take the rap. If the computer plays with one hundred percent accuracy what he has in mind—*and for certain types of music that is an absolute possibility*—then the audience gets more for their money. They get to hear the thing the way the composer imagined it.

With certain other types of music that require a lot of styling and nuance, it is difficult to put the same kind of element into the digital storage of the composition. If there are a lot of rubatos in it or a lot of dynamics, some of the computer music systems don't handle that kind of information too well. But if you're just talking about getting rhythms played correctly or the right pitches always in tune, stuff like that, it can be done.

C!: So do you think we'll see less emphasis placed on the performer in the next few years, on the people with the zippers and the hair?

ZAPPA: I think that the people with the zippers and the hair will be supplanted by people with zippers going in another direction and a different hairdo. That's pretty much the name of the game. No major event in American music culture—I'm talking financially—has ever occurred without the cooperation and assistance of the clothing industry. They're married. Every major cycle in rock and roll has been accompanied by clothing styles. Every time someone sells a record, someone else is selling a t-shirt or a pair of pants. It makes the world go 'round. ©

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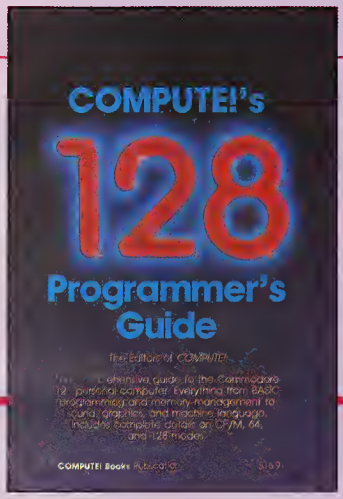

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Ben Elzer

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"Solitaire" is an electronic version of the familiar card game. Like the original, this game challenges you to put a deck of cards in order using the fewest possible moves. Type in and save the program listed for your computer, then read the instructions before you play the game.

Unshuffling The Deck

As you probably know, Solitaire has a very simple object. After shuffling a deck of playing cards, you must put them back in order, following a few simple rules. Though there are several different variations of the conventional game, here are the rules for this version:

When you run the program, the computer deals out four rows of 13 cards, then removes the aces, leaving four empty spaces. Your goal is to rearrange the cards into four rows of the same suit, putting the cards in each row in ascending order from the lowest (2) to the highest (king), without leaving any empty spaces between cards. That sounds simple enough. But since you must move a card into one of the four empty spaces, your choices for any given move are limited.

Your position on the screen is shown by a blinking cursor. Press the M key to move from the current position to another empty space. When you press P, the computer moves a card into the current space: Which card it puts there depends on which card is immediately to the left of the space. Whenever possible, the computer uses the next card in suit. For example, if the card to the left of your current position is the 2 of hearts, pressing P puts the 3 of hearts in the current space and puts a space where the 3 of hearts was before. If you press P on a space to the right of the queen of diamonds, the king of diamonds moves from its current position to that space, and so on. Each time you press P, one space is filled and another is emptied.

In this way you can gradually move cards into the right order. When you press P on a space at the beginning of a row, the computer asks which suit to play (hearts, clubs, spades, or diamonds). This determines the suit for that row. While it's possible to win on only one deal, most games require two or more deals. When no moves are possible (every empty space is followed by a king or another space), the computer automatically shuffles the remaining cards and deals them out again. Of course, it does not disturb cards that are already in correct order. You'll find that it takes considerable foresight to win consistently in only two or three deals. Completely random play results in an average of nine or ten deals.

Commodore Versions

Program 1 is Solitaire for the Commodore 64. It also works as listed for the Commodore 128. For the Commodore 16 and Plus/4, change line 20 to read as follows:

```
20 COLOR0,2,5:COLOR4,7,0
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program and Program 5 is a special binary file used to create the high resolution card displays. You must type in Program 5 with "Apple MLX," COMPUTE!'s machine language entry program for Apple, published elsewhere in this issue. Follow the MLX instructions carefully and be sure to save a copy of the program when you are done. Here are the addresses you need for MLX:

Starting address: 8000
Ending address: 8317

The program works on any Apple II-series computer, but the graphics look much better on a color monitor.

TI-99/4A Version

This version (Program 6) plays exactly like the others except that the rows of cards are displayed vertically rather than horizontally.

"Solitaire" for the Commodore 64.

Program 1: Commodore Solitaire

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 CLR:A=RND(-TI):PRINT"{CLR}"
   ;:F5=1:C=52:W=1          :rem 21
20 POKE53281,15:POKE53280,14
                            :rem 34
30 DIMP(4,I3),D(52),T(52)
                            :rem 2
40 GOSUB920:REM--DRAW BOXES--
                            :rem 0
50 PRINT"{HOME}{BLU}";TAB(I5);
   "SHUFFLING..."           :rem 224
60 GOSUB1020:REM--SHUFFLE DECK
   --                       :rem 159
70 PRINT"{HOME}";TAB(15);"DEAL
   ING...{6 SPACES}"        :rem 17
80 FORI=1TO4:FORJ=1TO13:GOSUB1
   080:NEXTJ:NEXTI          :rem 197
90 GOSUB1210:REM--FIND FIRST F
   OUR EMPTY BOXES          :rem 26
100 PRINT"{HOME}";"{BLU}TYPE '
   M' TO MOVE TO THE NEXT EMP
   TY SLOT"                 :rem 94
110 PRINT"OR 'P' TO PLACE A CA
   RD AT THE CURSOR"        :rem 89
120 IFW=5THENW=1:F1=0:GOSUB128
   0:IFF1=0THEN570          :rem 250
130 I=INT((E(W)-1)/13)+1:J=E(W
   )-13*INT((E(W)-1)/13)
                            :rem 181
140 IFJ=1THEN170            :rem 163
150 LL=P(I,J-1):IFLL/13=INT(LL
   /13)THENW=W+1:GOTOI20
                            :rem 61
160 IFLL=10RLL=14ORLL=27ORLL=4
   0THENW=W+1:GOTO120       :rem 60
170 N$="W":S$=" ":PRINT"{BLU}"
   ;:GOSUB1160              :rem 123
180 GETX$:IFX$=""THENPRINT"
   {YEL}";:GOSUB1160        :rem 22
190 IFX$<>""THEN210         :rem 37
200 GETX$:IFX$=""THENPRINT"
   {BLU}";:GOSUB1160:GOTO180
                            :rem 156
210 IFX$="P"THEN240         :rem 52
220 IFX$="M"THEN:N$=" ":GOSUB1
   160:W=W+1:GOTO120        :rem 210
230 GOTO180                 :rem 103
240 IFJ=1THEN370            :rem 166
250 LL=P(I,J-1)             :rem 42
260 IFLL/13=INT(LL/13)THEN180
                            :rem 190
270 IFLL=1ORLL=14ORLL=27ORLL=4
   0THEN180                 :rem 138
280 TE=P(I,J):TT=T(P(I,J)):L=T
   (P(I,J-1)+1)             :rem 118
290 T(P(1,J))=T(P(1,J-1)+1)
                            :rem 156
300 T(P(1,J-1)+1)=TT        :rem 55
310 P(I,J)=P(INT((L-1)/13+1),L
   -13*INT((L-1)/13)):rem 245
320 P(INT((L-1)/13)+1,L-13*INT
   ((L-1)/13))=TE           :rem 47
330 GOSUB1080               :rem 223
340 I=INT((L-1)/13)+1:J=L-13*I
   NT((L-1)/13):GOSUB1080
                            :rem 88
350 GOSUB1210:W=1:GOTO120
                            :rem 225
360 REM--OFFER CHOICE OF 'TWOS
   '                        :rem 36
370 PRINT"{HOME}":PRINT"
   {19 DOWN}"               :rem 204
380 PRINT"{8LU}";           :rem 198
390 PRINT"NOW YOU HAVE A CHOIC
   E OF"                    :rem 3
400 PRINT"WHICH '2' YOU WANT T
   O PLACE"                 :rem 151
410 PRINT"TWO OF 'S','H','D',O
   R 'C'";                  :rem 175
420 GETT$:IFT$=""THEN420
                            :rem 117
430 IFT$="S"THENN2=2:GOTO490
                            :rem 160
440 IFT$="H"THENN2=15:GOTO490
                            :rem 202
450 IFT$="D"THENN2=28:GOTO490
                            :rem 203
460 IFT$="C"THENN2=41:GOTO490
                            :rem 198
470 GOTO420                 :rem 106
480 REM--NOW EXCHANGE LOCATION
   S--                      :rem 23
490 TE=P(I,J):TT=T(P(I,J)):L=T
   (N2)                     :rem 223
500 T(P(I,J))=T(N2)         :rem 252
510 T(N2)=TT                :rem 160
520 PRINT"{HOME}":PRINT"
   {19 DOWN}"               :rem 201
530 PRINT"{25 SPACES}":rem 105
540 PRINT"{30 SPACES}":rem 106
550 PRINT"{30 SPACES}";
                            :rem 166
560 GOTO310                 :rem 104
570 FORI=1TO4               :rem 17
580 N(1)=0                  :rem 242
590 IFP(I,1)<>2ANDP(I,1)<>15AN
   DP(I,1)<>28ANDP(I,1)<>41TH
   EN650                    :rem 219
600 N(1)=1                  :rem 236
610 FORJ=2TO12              :rem 61
620 IFP(I,J)-1<>P(I,J-1)THENJ=
   14:GOTO640               :rem 69
630 N(1)=N(1)+1             :rem 2
640 NEXTJ                   :rem 35
650 NEXTI                   :rem 35
660 IFN(1)=12ANDN(2)=12ANDN(3)
   =12ANDN(4)=12THEN1350
                            :rem 98
670 F5=F5+1                 :rem 44
680 REM--ERASE THE WRONG ENTRI
   ES                       :rem 212
690 PRINT"{HOME}{39 SPACES}"
                            :rem 131
700 PRINT"{39 SPACES}";
                            :rem 163
710 N$=" ":S$=" "           :rem 189
720 PRINT"{HOME}{BLU}";TAB(15)
   ;"RESHUFFLING..."        :rem 171
730 FOR1=1TO52:D(1)=I:NEXT
                            :rem 89
740 FOR1=1TO4               :rem 16
750 FORJ=N(I)+1TO13         :rem 85
760 GOSUB1160               :rem 229
770 NEXT:NEXT               :rem 86
780 C3=52                   :rem 185
790 FORI=1TO4               :rem 21
800 IFN(I)=0THEN820         :rem 69
810 FORJ=1TON(I):D(P(I,J))=0:N
   EXTJ                     :rem 34
820 NEXTI                   :rem 34
830 FORI=1TO4:FORJ=1+N(I)TO13
                            :rem 3
840 R1=INT(RND(1)*C3+1)
                            :rem 250
850 IFD(R1)=0THEND(R1)=D(C3):C
   3=C3-1:GOTO840           :rem 16
860 P(I,J)=D(R1)            :rem 83
870 D(R1)=D(C3):C3=C3-1:NEXTJ
                            :rem 131
880 NEXTI                   :rem 40
890 FOR11=1TO52:T(11)=0:NEXT
                            :rem 233
900 GOSUB1060               :rem 224
910 GOTO70                  :rem 58
920 REM--SET UP BOXES       :rem 235
930 PRINT"{WHT}";           :rem 173
940 FORI=1TO4               :rem 18
950 PRINT:PRINT             :rem 242
960 FORJ=1TO12:PRINT"**{RB}";:N
   EXT:PRINT"**{SB}"        :rem 110
970 FORJ=1TO13:PRINT"
   {2 SPACES}_";:NEXT:PRINT
                            :rem 169
980 FORJ=1TO12:PRINT"**{EB}";:N
   EXT:PRINT"**{XB}"        :rem 126
990 NEXT                    :rem 225
1000 PRINT"{HOME}";         :rem 224
1010 RETURN                 :rem 162
1020 REM--SET UP DECK       :rem 169
1030 FORI=1TO52:D(I)=1:NEXT
                            :rem 131
1040 FORI=1TO4:FORJ=1TO13:R1=I
   NT(RND(1)*C+1):P(I,J)=D(R
   1):D(R1)=D(C):C=C-1
                            :rem 48
1050 NEXT:NEXT              :rem 126
1060 FORII=1TO4:FORJJ=1TOI3:T(
   P(II,JJ))=(II-1)*13+JJ:NE
   XT:NEXT                  :rem 62
1070 RETURN                 :rem 168
1080 REM--SHOW CARD P(I,J)
                            :rem 194
1090 S$="ASZX":S$=MID$(S$,INT(
   (P(I,J)-1)/13)+1,1)
                            :rem 127
1100 PRINT"{BLK}";:IFS$="S"ORS
   $="Z"THENPRINT"{RED}";
                            :rem 188
1110 N=P(I,J)-13*INT((P(I,J)-1
   )/13)                    :rem 71
```

To keep yourself from being burned to a crisp by a fire-breathing dragon, just cast a *nitfol* spell. Oops. Make that a *gondar* spell.

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```
>CAST THE NITFOL SPELL ON THE DRAGON
```

And the story responds:

```
THE DRAGON PAUSES AND ROARS OUT
A BENEVOLENT GREETING, WHICH, TO
YOUR CHAGRIN, FRIES YOU TO A
DELICATE CRISP. YOU HAVE DIED.
```

Suppose, on the other hand, you decide to invoke a spell that quenches open flames:

```
>CAST THE GONDAR SPELL ON THE
DRAGON
```

In that case the story responds:

```
THE DRAGON'S FLAME IS
DOUSED IN A TORRENT OF
RUSHING WATER. IT
DISAPPEARS WITH A
TORTUOUS SCREAM.
```

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```
YOU FEEL VERY FUNNY, SORT OF SQUASHED AND
PUSHED AND SQUEEZED. YOUR SURROUNDINGS ARE
WAVERING, THEN GROWING, THEN WAVERING AGAIN.
THE FEELING VANISHES, BUT YOUR SURROUNDINGS
ARE TEN TIMES THEIR FORMER SIZE...OR IS IT
THAT YOU ARE ONE-TENTH YOUR FORMER SIZE?
```

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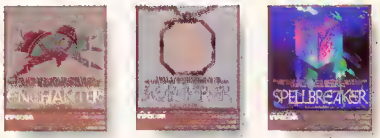

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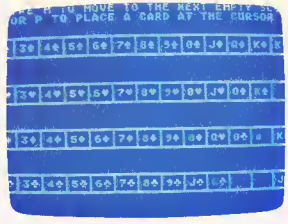
```
1120 IFN=1THENS$=" "          :rem 54
1130 N1$=" 234567890JQK":N$=MI
     D$(N1$,N,1)              :rem 93
1140 GOSUB1160                :rem 14
1150 RETURN                   :rem 167
1160 REM--PRINT N$;S$ AT POSIT
     ION I,J                  :rem 128
1170 PRINT"{HOME}":PRINT:PRINT
     :IFI=1THEN1190           :rem 181
1180 FORZ=2TO1:PRINT:PRINT:PRI
     NT:PRINT:PRINT:NEXT
                              :rem 194
1190 PRINTTAB(3*(J-1));N$;S$
                              :rem 53
1200 RETURN                   :rem 163
1210 Z=1                      :rem 140
1220 FORI=1TO52STEP13:E(Z)=T(1
     ):Z=Z+1:NEXT             :rem 98
1230 FORJ=1TO4                :rem 60
1240 FORI=1TO3:IFE(1)>E(I+1)TH
     ENAA=E(I):E(I)=E(I+1):E(I
     +1)=AA                   :rem 238
1250 NEXT                      :rem 7
1260 NEXT                      :rem 8
1270 RETURN                   :rem 170
1280 REM--CHECK TO SEE IF ALL
     {SPACE}FOUR SPACES FOLLOW
     S A KING OR BLANK:rem 227
1290 FORK=1TO4                :rem 67
1300 X=INT((E(K)-1)/13+1):Y=E(
     K)-13*INT((E(K)-1)/13)
                              :rem 223
1310 IFY=1THENF1=1            :rem 47
1320 W2=P(X,Y-1):IFW2<>1ANDW2<
     >14ANDW2<>27ANDW2<>40ANDW
     2/13<>INT(W2/13)THENF1=1
                              :rem 238
1330 NEXT:RETURN              :rem 32
1340 REM--ALL DONE...         :rem 143
1350 PRINT"{HOME}[20 DOWN]";"
     {BLU}CONGRATULATIONS!!";
                              :rem 153
1360 PRINT" YOU WON!!":PRINT"I
     T TOOK YOU";F5"TRIES"
                              :rem 49
1370 PRINT"TYPE 'Y' TO PLAY AG
     AIN";                    :rem 249
1380 GETX$:IFX$=""THEN1380
                              :rem 233
1390 IFX$="N"THENEND          :rem 173
1400 IFX$="Y"THEN10           :rem 58
1410 GOTO1380                 :rem 203
```

Program 2: Atari Solitaire

Version by Kevin Mykytyn, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
DH 10 REM INITIALIZE
DH 20 GRAPHICS 0:OPEN #1,4,0
      ,"K:":POKE 82,0:POKE 7
      52,1
JF 30 CLR :DIM X$(10),N$(15)
      ,N1$(15),A$(10),S$(10)
      ,E(52),P(4,13),O(52),T
      (52),T$(10),N(10)
HD 40 PRINT "{CLEAR}":POSITI
      ON 15,9:PRINT "SOLITAI
      RE":POSITION 10,11:PRI
      NT "HIT ANY KEY TO STA
      RT"
GP 50 A=RND(PEEK(53770)):GET
      #1,A
CA 60 PRINT CHR$(125):F5=1:C
      =52:W=1
IB 70 GOSUB 810:POSITION 12,
      0:PRINT "SHUFFLING..."
```



Atari version of "Solitaire."

```
      :GOSUB 860
CF 80 POSITION 12,0:PRINT "
      OEALING...{3 SPACES}"
PC 90 FOR I=1 TO 4:FOR J=1 T
      O 13:GOSUB 910:NEXT J:
      NEXT I:GOSUB 980
JK 100 POSITION 0,0:PRINT "
       TYPE M TO MOVE TO THE
       NEXT EMPTY SLOT"
AL 110 PRINT "  OR P TO PLAC
       E A CARD AT THE CURSO
       R"
PA 120 IF W=5 THEN W=1:F1=0:
       GOSUB 1010:IF F1=0 TH
       EN 560
LF 130 I=INT((E(W)-1)/13)+1:
       J=E(W)-13*INT((E(W)-1
       )/13)
KD 140 IF J=1 THEN 170
DN 150 LL=P(I,J-1):IF LL/13=
       INT(LL/13) THEN W=W+1
       :GOTO 120
DM 160 IF LL=1 OR LL=14 OR L
       L=27 OR LL=40 THEN W=
       W+1:GOTO 120
HP 170 N$=CHR$(20):Q=0:S$="
       ":GOSUB 970
DB 180 POKE 764,255
CP 190 A=PEEK(764):Q=((Q=0)*
       12):N$=CHR$(Q+20):IF
       A=255 THEN GOSUB 970
DL 200 IF A<>255 THEN 220
IA 210 A=PEEK(764):N$=CHR$(Q
       +20):IF A=255 THEN GO
       SUB 970:GOTO 190
MF 220 GET #1,X:X$=CHR$(X):I
       F X$="P" THEN 250
HB 230 IF X$="M" THEN N$=" "
       :GOSUB 970:W=W+1:GOTO
        120
GJ 240 GOTO 190
KI 250 IF J=1 THEN 380
CL 260 LL=P(I,J-1)
MA 270 IF LL/13=INT(LL/13) T
       HEN 190
IM 280 IF LL=1 OR LL=14 OR L
       L=27 OR LL=40 THEN 19
       0
HH 290 TE=P(I,J):TT=T(P(I,J)
       ):L=T(P(I,J-1)+1)
JE 300 T(P(I,J))=T(P(I,J-1)+
       1)
DI 310 T(P(I,J-1)+1)=TT
PG 320 P(I,J)=P(INT((L-1)/13
       +1),L-13*INT((L-1)/13
       ))
DA 330 P(INT((L-1)/13)+1,L-1
       3*INT((L-1)/13))=TE
LB 340 GOSUB 910
CK 350 I=INT((L-1)/13)+1:J=L
       -13*INT((L-1)/13):GOS
       UB 910
LP 360 GOSUB 980:W=1:GOTO 12
       0
HN 370 REM OFFER CHOICE OF T
       WOS
```

```
MG 380 N$=CHR$(20):GOSUB 970
       :POSITION 0,21
AD 390 PRINT "NOW YOU HAVE A
        CHOICE OF"
JH 400 PRINT "WHICH '2' YOU
       WANT TO PLACE"
KP 410 PRINT "TWO OF 'S','H'
       ,'O',OR 'C' ";
NP 420 GET #1,T:T$=CHR$(T)
KA 430 IF T$="S" THEN N2=2:G
       OTO 490
MK 440 IF T$="H" THEN N2=15:
       GOTO 490
ML 450 IF T$="O" THEN N2=28:
       GOTO 490
MG 460 IF T$="C" THEN N2=41:
       GOTO 490
GK 470 GOTO 420
GD 480 REM NOW EXCHANGE LOCA
       TIONS
NP 490 TE=P(I,J):TT=T(P(I,J)
       ):L=T(N2)
PM 500 T(P(I,J))=T(N2)
KA 510 T(N2)=TT
ML 520 POSITION 0,21
AE 530 FOR A=1 TO 3:PRINT "
       {37 SPACES}";:NEXT A
GH 540 GOTO 320
IL 550 REM PLAYER CANNOT MOV
       E SO RESHUFFLE
JP 560 FOR I=1 TO 4:N(I)=0
MG 570 IF P(I,1)<>2 ANO P(I,
       1)<>15 ANO P(I,1)<>28
        ANO P(I,1)<>41 THEN
       620
PD 580 N(I)=1
CI 590 FOR J=2 TO 12:IF P(I,
       J)-1<>P(I,J-1) THEN J
       =14:GOTO 610
PP 600 N(I)=N(I)+1
CA 610 NEXT J
CA 620 NEXT I
FO 630 IF N(1)=12 ANO N(2)=1
       2 ANO N(3)=12 ANO N(4
       )=12 THEN 1070
CJ 640 F5=F5+1
HH 650 REM ERASE THE WRONG E
       NTRIES
FB 660 FOR A=0 TO 1:POSITION
       0,A:PRINT "
       {38 SPACES}";:NEXT A
NF 670 N$=" ":S$=" ":POSITIO
       N 13,0:PRINT "RESHUFF
       LING.. "
KG 680 FOR I=1 TO 52:O(I)=I:
       NEXT I
OB 690 FOR I=1 TO 4:FOR J=N(
       I)+1 TO 13:GOSUB 970:
       NEXT J:NEXT I
GA 700 C3=52:FOR I=1 TO 4
EF 710 IF N(I)=0 THEN 730
CC 720 FOR J=1 TO N(I):O(P(I
       ,J))=0:NEXT J
CC 730 NEXT I
AD 740 FOR I=1 TO 4:FOR J=1+
       N(I) TO 13
PK 750 R1=INT(RND(1)*C3+1)
BA 760 IF O(R1)=0 THEN O(R1)
       =O(C3):C3=C3-1:GOTO 7
       50
DD 770 P(I,J)=O(R1):O(R1)=O(
       C3):C3=C3-1:NEXT J:NE
       XT I
HJ 780 FOR II=1 TO 52:T(II)=
       0:NEXT II
JM 790 GOSUB 890:GOTO 80
IO 800 REM SET UP BOXES
JM 810 FOR I=1 TO 4:PRINT :P
       RINT
CA 820 A$=CHR$(18):FOR J=1 T
       O 12:PRINT A$;A$;CHR$
       (23);:NEXT J:PRINT A$
       ;A$;CHR$(5)
DF 830 FOR J=1 TO 13:PRINT "
```

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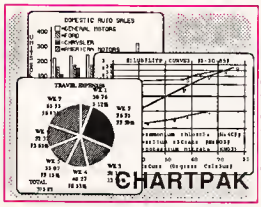

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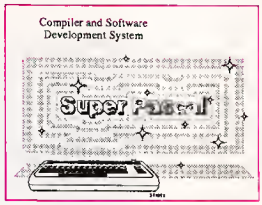

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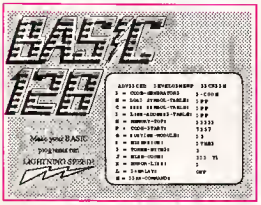

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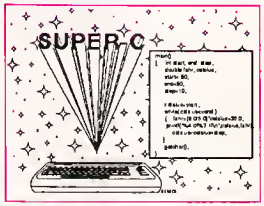

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```
        ";CHR$(124);:NEXT J
      :PRINT
KB B40  FOR J=1 TO 12:PRINT A
      $;A$;CHR$(24);:NEXT J
      :PRINT A$;A$;CHR$(3):
      NEXT I:POSITION 0,0:R
      ETURN
CJ B50  REM SET UP DECK
KG B60  FOR I=1 TO 52:O(I)=I:
      NEXT I
AK B70  FOR I=1 TO 4:FOR J=1
      TO 13:R1=INT(RND(1)*C
      +1):P(I,J)=O(R1):O(R1
      )=O(C):C=C-1
OL B80  NEXT J:NEXT I
FI B90  FOR II=1 TO 4:FOR JJ=
      1 TO 13:T(P(II,JJ))=(
      II-1)*13+JJ:NEXT JJ:N
      EXT II:RETURN
MI 900  REM SHOW CARD
AD 910  S$="{;}{,}{CP}":Q=INT
      ((P(I,J)-1)/13)+1:S$=
      S$(Q,Q)
BP 920  N=P(I,J)-13*INT((P(I,
      J)-1)/13)
AO 930  IF N=1 THEN S$=" "
CI 940  N1$="  2345678910JQK":N
      $=N1$(N,N)
NI 950  GOSUB 970:RETURN
MK 960  REM LOCATE CARD POSIT
      ION
FD 970  POSITION J*3-3,I*5-1:
      PRINT N$;S$:RETURN
IJ 980  Z=1:FOR I=1 TO 52 STE
      P 13:E(Z)=T(I):Z=Z+1:
      NEXT I
HJ 990  FOR J=1 TO 4:FOR I=1
      TO 3:IF E(I)>E(I+1) T
      HEN AA=E(I):E(I)=E(I+
      1):E(I+1)=AA
CB 1000 NEXT I:NEXT J:RETURN

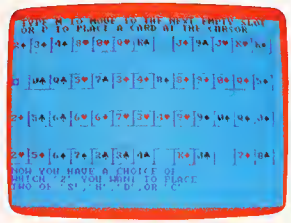
DJ 1010 FOR K=1 TO 4
NO 1020 X=INT((E(K)-1)/13+1)
      :Y=E(K)-13*INT((E(K)
      -1)/13)
CO 1030 IF Y=1 THEN F1=1
ON 1040 W2=P(X,Y-1):IF W2<>1
      AND W2<>14 AND W2<>
      27 AND W2<>40 AND W2
      /13<>INT(W2/13) THEN
       F1=1
GK 1050 NEXT K:RETURN
JM 1060 REM YOU WON
HI 1070 POSITION 12,20:PRINT
       "CONGRATULATIONS!!"
LB 1080 POSITION 16,21:PRINT
       "YOU WON!!":POSITIO
      N 11,22:PRINT "IT TO
      OK YOU ";F5;" TRIES"
JJ 1090 POSITION 10,23:PRINT
       "TYPE 'Y' TO PLAY A
      GAIN";
AB 1100 GET #1,X:X$=CHR$(X):
      IF X$="Y" THEN GOTO
      30
KD 1110 IF X$="N" THEN END
LP 1120 GOTO 1100
```

Program 3: IBM PC/PCjr Solitaire

Version by Kevin Mykytyn, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
CJ 10 REM INITIALIZE
KA 20 KEY OFF:DEF SEG=0:POKE 104
      7,PEEK(1047)OR 64:WIDTH 40
PJ 30 CLEAR:COLOR 1,3,12:CLS:LOC
      ATE 10,16,0:PRINT "SOLITAI
      RE":PRINT:PRINT SPC(10) "H
      IT ANY KEY TO START"
ON 40 A=RND(1):A$=INKEY$:IF A$="
      " THEN 40 ELSE CLS:F5=1:C=
      52:W=1
HN 50 DIM P(4,13),O(52),T(52):GO
      SUB 770:LOCATE 1,13:PRINT
      "SHUFFLING...":GOSUB 820
LC 60 LOCATE 1,13:PRINT " DEALIN
      G...
      "
JP 70 FOR I=1 TO 4:FOR J=1 TO 13
      :GOSUB 870:NEXT J:NEXT I:G
      OSUB 950
ML 80 COLOR 0,3,12:LOCATE 1,1:PR
      INT " TYPE M TO MOVE TO TH
      E NEXT EMPTY SLOT"
```



IBM PC/PCjr "Solitaire."

```
EO 90 PRINT "  OR P TO PLACE A C
      ARD AT THE CURSOR"
PK 100  IF W=5 THEN W=1:F1=0:GOSU
      B 980:IF F1=0 THEN 520
IO 110  I=INT((E(W)-1)/13)+1:J=E(
      W)-13*INT((E(W)-1)/13)
NA 120  IF J=1 THEN 150
IH 130  LL=P(I,J-1):IF LL/13=INT(
      LL/13) THEN W=W+1:GOTO 10
      0
CI 140  IF LL=1 OR LL=14 OR LL=27
       OR LL=40 THEN W=W+1:GOTO
       100
KI 150  N$=CHR$(8):S$=" ":COLOR 1
      ,3,12:GOSUB 940:DEF SEG=0
      :POKE 1050,PEEK(1052)
FP 160  X$=INKEY$:IF X$="" THEN C
      OLOR 14,3,12:GOSUB 940
DG 170  IF X$<>"" THEN 190
OJ 180  X$=INKEY$:IF X$="" THEN C
      OLOR 1,3,12:GOSUB 940:GOT
      O 160
KE 190  IF X$="P" THEN 210
FL 200  IF X$="M" THEN N$=" ":GOS
      UB 940:W=W+1:GOTO 100:ELS
      E 160
OP 210  IF J=1 THEN 340
BB 220  LL=P(I,J-1)
IE 230  IF LL/13=INT(LL/13) THEN
       160
NE 240  IF LL=1 OR LL=14 OR LL=27
       OR LL=40 THEN 160
JM 250  TE=P(I,J):TT=T(P(I,J)):L=
      T(P(I,J-1)+1)
JB 260  T(P(I,J))=T(P(I,J-1)+1)
GB 270  T(P(I,J-1)+1)=TT
NJ 280  P(I,J)=P(INT((L-1)/13+1),
      L-13*INT((L-1)/13))
MB 290  P(INT((L-1)/13)+1,L-13*IN
      T((L-1)/13))=TE
NL 300  GOSUB 870
BF 310  I=INT((L-1)/13)+1:J=L-13*
      INT((L-1)/13):GOSUB 870
FD 320  GOSUB 950:W=1:GOTO 100
QJ 330  REM OFFER CHOICE OF TWOS
JI 340  LOCATE 21,1:COLOR 1,3,12
AE 350  PRINT "NOW YOU HAVE A CHO
      ICE OF"
HO 360  PRINT "WHICH '2' YOU WANT
       TO PLACE"
CN 370  PRINT "TWO OF 'S','H','D'
      ,OR 'C' "
HB 380  T$=INKEY$:IF T$="" THEN 3
      80
JO 390  IF T$="S" THEN N2=2:GOTO
       450
BL 400  IF T$="H" THEN N2=15:GOTO
       450
EM 410  IF T$="D" THEN N2=28:GOTO
       450
MI 420  IF T$="C" THEN N2=41:GOTO
       450
HB 430  GOTO 380
JF 440  REM NOW EXCHANGE LOCATION
      S
KL 450  TE=P(I,J):TT=T(P(I,J)):L=
      T(N2)
LL 460  T(P(I,J))=T(N2)
FH 470  T(N2)=TT
BJ 480  LOCATE 21,1
CA 490  FOR A=1 TO 3:PRINT "
      ":NEXT
GC 500  GOTO 280
EA 510  REM PLAYER CANNOT MOVE SO
       RESHUFFLE
FA 520  FOR I=1 TO 4:N(I)=0
FL 530  IF P(I,1)<>2 AND P(I,1)<>
      15 AND P(I,1)<>28 AND P(I
      ,1)<>41 THEN 580
IJ 540  N(I)=1
LI 550  FOR J=2 TO 12:IF P(I,J)-1
      <>P(I,J-1) THEN J=14:GOTO
       570
BB 560  N(I)=N(I)+1
QD 570  NEXT J
OL 580  NEXT I
KP 590  IF N(1)=12 AND N(2)=12 AN
      D N(3)=12 AND N(4)=12 THE
      N 1040
ND 600  F5=F5+1
CP 610  REM ERASE THE WRONG ENTRI
      ES
BD 620  LOCATE 1,1:FOR A=1 TO 2:P
      RINT "
                              ";:NE
      XT
OA 630  N$=" ":S$=" ":LOCATE 1,1:
      COLOR 1,3,12:PRINT TAB(13
      );"RESHUFFLING..."
OB 640  FOR I=1 TO 52:O(I)=I:NEXT
EI 650  FOR I=1 TO 4:FOR J=N(I)+1
       TO 13:GOSUB 940:NEXT J,I
EE 660  C3=52:FOR I=1 TO 4
BI 670  IF N(I)=0 THEN 690
NE 680  FOR J=1 TO N(I):O(P(I,J))
      =0:NEXT J
OO 690  NEXT I
OK 700  FOR I=1 TO 4:FOR J=1+N(I)
       TO 13
BG 710  R1=INT(RND(1)*C3+1)
PL 720  IF O(R1)=0 THEN O(R1)=O(C
      3):C3=C3-1:GOTO 710
PK 730  P(I,J)=O(R1):O(R1)=O(C3):
      C3=C3-1:NEXT J,I
QI 740  FOR II=1 TO 52:T(II)=0:NE
      XT
LA 750  GOSUB 850:GOTO 60
IK 760  REM SET UP BOXES
MO 770  COLOR 1,3,12:FOR I=1 TO 4
      :PRINT:PRINT
PG 780  A$=CHR$(196):FOR J=1 TO 1
      2:PRINT A$;A$;CHR$(194);:
      NEXT:PRINT A$;A$;CHR$(191
      )
PE 790  FOR J=1 TO 13:PRINT "  ";
      CHR$(179);:NEXT:PRINT
KH 800  FOR J=1 TO 12:PRINT A$;A$
      ;CHR$(193);:NEXT:PRINT A$
      ;A$;CHR$(217):NEXT:LOCATE
       1,1:RETURN
GD 810  REM SET UP DECK
OP 820  FOR I=1 TO 52:O(I)=I:NEXT
```

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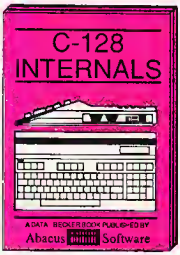

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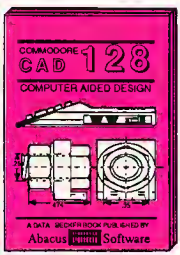

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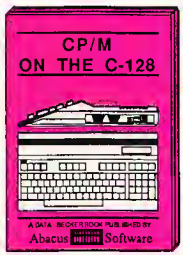

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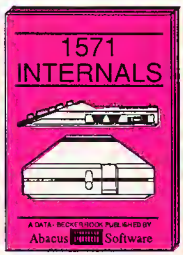

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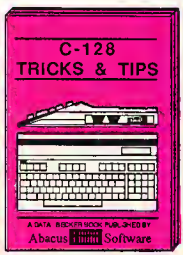

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```
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       3:R1=INT(RND(1)*C+1):P(I,
       J)=O(R1):O(R1)=O(C):C=C-1
FN 840 NEXT:NEXT
HF 850 FOR II=1 TO 4:FOR JJ=1 TO
       13:T(P(II,JJ))=(II-1)*13
       +JJ:NEXT:NEXT:RETURN
QI 860 REM SHOW CARD
NP 870 S$=CHR$(6)+CHR$(3)+CHR$(4
       )+CHR$(S):S$=MID$(S$,INT(
       (P(I,J)-1)/13)+1,1)
K8 880 COLOR 0,3,12:IF S$=CHR$(3
       ) OR S$=CHR$(4) THEN COLO
       R 4,3,12
KO 890 N=P(I,J)-13*INT((P(I,J)-1
       )/13)
DP 900 IF N=1 THEN S$=" "
BF 910 N1$=" 23456789DJQK":N$=MI
       D$(N1$,N,1)
MC 920 GOSUB 940:RETURN
JO 930 REM LOCATE CARD POSITION
PH 940 LOCATE I*5-1,J*3-2:PRINT
       N$;S$:RETURN
IL 950 Z=1:FOR I=1 TO S2 STEP 13
       :E(Z)=T(I):Z=Z+1:NEXT
LA 960 FOR J=1 TO 4:FOR I=1 TO 3
       :IF E(I)>E(I+1) THEN AA=E
       (I):E(I)=E(I+1):E(I+1)=AA
CF 970 NEXT I,J:RETURN
IF 980 FOR K=1 TO 4
FO 990 X=INT((E(K)-1)/13+1):Y=E(
       K)-13*INT((E(K)-1)/13)
NG 1000 IF Y=1 THEN F1=1
HE 1010 W2=P(X,Y-1):IF W2<>1 AND
        W2<>14 AND W2<>27 AND W
       2<>40 AND W2/13<>INT(W2/
       13) THEN F1=1
JA 1020 NEXT:RETURN
KP 1030 REM YOU WON
FN 1040 LOCATE 21,13:COLOR 14,3,
       12:PRINT "CONGRATULATION
       S!!"
EI 1050 PRINT SPC(16)"YOU WON!!"
       :PRINT SPC(11)"IT TOOK Y
       OU";F5;"TRIES"
GL 1060 PRINT SPC(10)"TYPE 'Y' T
       O PLAY AGAIN";
IN 1070 X$=INKEY$:IF X$="Y" THEN
        30 ELSE IF X$="N" THEN
       END ELSE GOTO 1070
```

Apple "Solitaire."

Program 4: Apple Solitaire

Version by Tim Victor, Editorial Programmer

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
E0 10 HOME : POKE 230,32: POKE 2
       8,42: CALL 62454
87 12 PRINT CHR$ (4);"BLOAD CARD
       PLOT"
ZZ 15 POKE 49239,0: POKE 49235,0
       : POKE 49232,0:FS = 1:C =
       S2:W = 1
A7 20 DIM P(4,13),O(S2),T(S2)
B9 30 GOSUB 1000
39 40 GOSUB 1600: HTAB 15: PRINT
       "SHUFFLING..."
0C 50 GOSUB 1100
8E 60 GOSUB 1600: HTAB 15: PRINT
       "DEALING..."
FC 70 FOR I = 1 TO 4: FOR J = 1
       TO 13: GOSUB 1200: NEXT J:
       NEXT I
12 80 GOSUB 1400
58 90 GOSUB 1600: PRINT "TYPE 'M
       ' TO MOVE TO THE NEXT EMPT
       Y SLOT"
4F 100 PRINT "OR 'P' TO PLACE A
       CARD AT THE CURSOR"
C8 110 IF W = S THEN W = 1:F1 =
       0: GOSUB 1500: IF F1 = 0
       THEN 600
FE 120 I = INT ((E(W) - 1) / 13)
       + 1:J = E(W) - 13 * (I -
       1)
4A 130 IF J = 1 THEN 160
8A 140 LL = P(I,J - 1): IF LL /
       13 = INT (LL / 13) THEN W
       = W + 1: GOTO 110
F8 150 IF LL = 13 * INT (LL / 13
       ) + 1 THEN W = W + 1: GOT
       O 110
58 160 HCOLOR= 3: GOSUB 1700
24 170 GET X$: IF X$ > "Z" THEN
       X$ = CHR$ ( ASC (X$) - 32
       )
66 175 HCOLOR= 1: GOSUB 1700
9E 180 IF X$ = "P" THEN 210
46 190 IF X$ = "M" THEN W = W +
       1: GOTO 110
2C 195 IF X$ = CHR$ (3) THEN TEX
       T : END
91 200 GOTO 160
B6 210 IF J = 1 THEN 400
21 220 TE = P(I,J):TT = T(P(I,J)
       ):L = T(P(I,J - 1) + 1)
12 230 T(P(I,J)) = T(P(I,J - 1)
       + 1)
C8 240 T(P(I,J - 1) + 1) = TT
A8 250 P(I,J) = P( INT ((L - 1)
       / 13 + 1),L - 13 * INT ((
       L - 1) / 13))
85 260 P( INT ((L - 1) / 13) + 1
       ,L - 13 * INT ((L - 1) /
       13)) = TE
D8 270 GOSUB 1200
89 280 I = INT ((L - 1) / 13 + 1
       ):J = L - 13 * INT ((L -
       1) / 13): GOSUB 1200
58 290 GOSUB 1400:W = 1: GOTO 90
2A 400 GOSUB 1600: PRINT "NOW YO
       U HAVE A CHOICE OF"
D4 410 PRINT "WHICH '2' YOU WANT
        TO PLACE"
76 420 GET T$: IF ASC (T$) > 96
       THEN T$ = CHR$ ( ASC (T$)
       - 32)
A6 430 C = 0: FOR K = 1 TO 4: IF
       T$ = MID$ ("SHOC",K,1) T
       HEN C = K:K = 4
88 435 NEXT : IF C = 0 THEN 420
28 440 N2 = C * 13 - 11:TE = P(I
       ,J):TT = T(P(I,J)):L = T(
       N2)
81 450 T(P(I,J)) = T(N2)
2C 460 T(N2) = TT
21 470 GOTO 250
F9 600 FOR I = 1 TO 4
11 610 N(I) = 0
58 620 IF P(I,1) < > 13 * INT (P
       (I,1) / 13) + 2 THEN 665
16 630 N(I) = 1
B8 640 FOR J = 2 TO 12: IF P(I,J
       ) - 1 < > P(I,J - 1) THEN
       J = 14: GOTO 660
ED 650 N(I) = N(I) + 1
0A 660 NEXT
1E 665 NEXT
88 670 IF N(1) = 12 AND N(2) = 1
       2 AND N(3) = 12 AND N(4)
       = 12 THEN 2000
CF 680 F5 = F5 + 1
B6 685 PP = 1
81 690 GOSUB 1600: HTAB (15): PR
       INT "RESHUFFLING"
A5 700 FOR I = 1 TO 52:O(I) = I:
       NEXT
FC 710 FOR I = 1 TO 4
8A 720 FOR J = N(I) + 1 TO 13
D1 730 GOSUB 1210
C8 740 NEXT : NEXT
8D 750 C3 = 52
87 760 FOR I = 1 TO 4
1D 765 IF N(I) = 0 THEN 780
82 770 FOR J = 1 TO N(I):O(P(I,J
       )) = 0: NEXT
0F 780 NEXT
24 790 FOR I = 1 TO 4: FOR J = N
       (I) + 1 TO 13
59 800 R1 = INT ( RND (1) * C3 +
       1)
15 810 IF O(R1) = 0 THEN O(R1) =
       O(C3):C3 = C3 - 1: GOTO
       800
87 820 P(I,J) = O(R1)
22 830 O(R1) = O(C3):C3 = C3 - 1
       : NEXT : NEXT
88 840 FOR II = 1 TO 52:T(II) =
       0: NEXT
DC 850 GOSUB 1130
8E 860 GOTO 60
D1 1000 RETURN
F8 1100 FOR I = 1 TO 52:O(I) = I
       : NEXT
57 1110 FOR I = 1 TO 4: FOR J =
       1 TO 13:R1 = INT ( RND (
       1) * C + 1):P(I,J) = O(R
       1):O(R1) = O(C):C = C -
       1
2F 1120 NEXT : NEXT
62 1130 FOR II = 1 TO 4: FOR JJ
       = 1 TO 13:T(P(II,JJ)) =
       (II - 1) * 13 + JJ: NEXT
       : NEXT
E3 1140 RETURN
3E 1200 PP = P(I,J)
28 1210 CALL 32768,PP,J * 20 - 9
       ,I * 36 - 22: RETURN
35 1400 Z = 1
C6 1410 FOR I = 1 TO 52 STEP 13:
       E(Z) = T(I):Z = Z + 1: N
       EXT
0C 1420 FOR J = 1 TO 3: FOR I =
       1 TO 4 - J
1C 1430 IF E(I) > E(I + 1) THEN
       AA = E(I):E(I) = E(I + 1
       ):E(I + 1) = AA
6E 1440 NEXT : NEXT : RETURN
A4 1500 FOR K = 1 TO 4
9F 1510 X = INT ((E(K) - 1) / 13
       + 1):Y = E(K) - 13 * IN
       T ((E(K) - 1) / 13)
A7 1520 IF Y = 1 THEN F1 = 1
52 1530 W2 = P(X,Y - 1): IF W2 <
       > 13 * INT (W2 / 13) +
       1 AND W2 / 13 < > INT (W
       2 / 13) THEN F1 = 1
45 1540 NEXT : RETURN
C4 1600 VTAB 21: HTAB 1: POKE 35
       ,25: FOR QQ = 1 TO 4: PR
       INT SPC( 40): NEXT
39 1610 POKE 35,24: VTAB 21: HTA
       B 1: RETURN
E6 1700 X = J * 20 - 8:Y = I * 3
       6 - 20: HPLOT X,Y TO X +
       14,Y TO X + 14,Y + 19 T
       O X,Y + 19 TO X,Y
E3 1710 RETURN
86 2000 GOSUB 1600: PRINT "CONGR
       ATULATIONS!!"
```

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```
1@ 2010 PRINT "YOU WON!!!": PRINT
       "IT TOOK YOU ";F5;" TRI
       ES"
7C 2020 PRINT "TYPE 'Y' TO PLAY
       AGAIN";
B2 2030 GET X$: IF ASC (X$) > 96
       THEN X$ = CHR$ ( ASC (X
       $) - 32)
73 2040 IF X$ = "N" THEN END
E6 2050 IF X$ = "Y" THEN RUN
78 2060 GOTO 2030
```

Program 5: Apple Graphics File

For instructions on entering this listing, please refer to the "Apple MLX" article published elsewhere in this issue.

```
START ADDRESS:  8000
END ADDRESS:    8313

8000: 20 EC 80 80 72 20 02 82 02
8008: 80 6D 20 5D 82 B0 68 AD E8
8010: 20 83 F0 0F A9 7F 8D 26 9D
8018: 83 8D 27 83 A9 07 8D 28 08
8020: 83 D0 0F A9 55 8D 26 83 44
8028: A9 2A 8D 27 83 A9 05 8D 07
8030: 28 83 A9 03 8D 14 83 A9 F8
8038: 02 8D 1C 83 20 08 81 A9 33
8040: 18 8D 15 83 20 9A 81 20 1A
8048: 5E 81 EE 18 83 CE 15 83 3D
8050: D0 F2 AD 20 83 F0 20 A0 EE
8058: 00 AD 21 83 20 88 80 A0 E5
8060: 04 AD 21 83 20 88 80 A0 EF
8068: 08 AD 20 83 20 88 80 A0 D9
8070: 0C AD 20 83 20 88 80 60 A3
8078: 74 82 03 08 94 82 0A 08 FF
8080: AC 82 01 01 AC 82 0A 0F 38
8088: 0A 0A 0A 8D 25 83 89 78 4E
8090: 80 85 FC C8 89 78 80 85 95
8098: FD C8 AD 22 83 8D 1A 83 AC
80A0: 89 78 80 C8 18 6D 23 83 79
80A8: C9 07 90 07 E9 07 EE 1A 36
80B0: 83 80 F5 8D 18 83 89 78 0A
80B8: 80 18 6D 24 83 8D 18 83 F5
80C0: A9 01 8D 14 83 A9 07 8D 28
80C8: 1C 83 A9 08 8D 15 83 AC E2
80D0: 25 83 81 FC 8D 26 83 20 77
80D8: 08 81 20 9A 81 20 5E 81 38
80E0: EE 18 83 EE 25 83 CE 15 A8
80E8: 83 D0 E4 60 20 A9 82 C9 F7
80F0: 35 90 01 60 A2 00 8E 21 2A
80F8: 83 C9 0E 90 07 E9 0D EE E1
8100: 21 83 80 F5 E9 00 8D 20 74
8108: 83 18 60 AD 14 83 8D 16 99
8110: 83 A8 A9 00 99 26 83 AD 4E
8118: 18 83 18 6D 1C 83 C9 07 EC
8120: 90 05 E9 07 EE 16 83 8D 8E
8128: 1D 83 AD 26 83 09 7F 8D 7F
8130: 17 83 AC 18 83 F0 15 A2 93
8138: 00 0E 26 83 8D 26 83 0A 53
8140: 3E 27 83 E8 EC 16 83 D0 C2
8148: F3 88 D0 E8 AC 16 83 89 8E
8150: 26 83 09 80 2D 17 83 99 D6
8158: 26 83 88 10 F2 60 AC 1D F0
8160: 83 89 8C 81 AC 16 83 88 8A
8168: 31 FE 19 26 83 91 FE 88 32
8170: 30 0A F0 08 89 26 83 91 A8
8178: FE 88 D0 F8 AC 18 83 89 59
8180: 93 81 A0 00 31 FE 0D 26 87
8188: 83 91 FE 60 7F 7E 7C 78 FE
8190: 70 60 40 00 01 03 07 0F 1D
8198: 1F 3F AD 18 83 29 3F A8 1A
81A0: 89 C2 81 05 E6 85 FF AD AC
81A8: 18 83 29 08 F0 02 A9 80 A1
81B0: 18 2C 18 83 70 04 10 04 8D
81B8: 69 28 69 28 6D 1A 83 85 8A
81C0: FE 60 00 04 08 0C 10 14 40
81C8: 18 1C 00 04 08 0C 10 14 C3
81D0: 18 1C 01 05 09 0D 11 15 08
81D8: 19 1D 01 05 09 0D 11 15 D3
81E0: 19 1D 02 06 0A 0E 12 16 18
81E8: 1A 1E 02 06 0A 0E 12 16 E3
81F0: 1A 1E 03 07 00 0F 13 17 2B
81F8: 18 1F 03 07 00 0F 13 17 F3
8200: 18 1F A9 00 8D 1A 83 8D F8
8208: 18 83 20 69 82 8D 19 83 16
8210: C0 01 90 12 F0 01 60 C9 FE
8218: 18 90 01 60 A9 24 8D 1A 86
8220: 83 A9 04 8D 18 83 A9 00 E4
8228: 8D 1F 83 A9 E0 8D 1E 83 C3
8230: AD 19 83 C0 1E 83 90 04 C3
8238: ED 1E 83 3B 2E 1F 83 4E F2
8240: 1E 83 90 EF 18 6D 18 83 76
8248: 8D 18 83 8D 23 83 18 AD 29
8250: 1F 83 6D 1A 83 8D 1A 83 1F
8258: 8D 22 83 18 60 20 69 82 77
8260: 8D 18 83 8D 24 83 C9 C0 FE
8268: 60 20 81 00 20 05 E1 A5 5A
8270: A1 A4 A0 60 7F 7F 5F 07 49
8278: 01 01 0F 7F 7F 7F 77 55 56
8280: 55 57 5F 7F 7F 7F 5F 57 F9
8288: 55 57 5F 7F 7F 7F 47 47 C1
8290: 01 01 47 7F 7F 7F 7E AE
8298: 78 78 7F 7F 7F 7F 7E 7A 51
82A0: 7A 7E 7F 7F 7F 7F 7F 7E E1
82A8: 7A 7E 7F 7F 7F 7F 7F 7F EA
82B0: 7E 7E 7F 7F 63 1C 1F 1F 65
82B8: 63 7C 7C 00 63 1C 1F 63 48
82C0: 1F 1F 1C 63 4F 47 43 49 3E
82C8: 4C 00 4F 4F 00 7C 7C 60 1E
82D0: 1F 1F 1C 63 43 79 7C 60 40
82D8: 1C 1C 1C 63 00 1C 1F 4F AA
82E0: 67 73 73 73 63 1C 1C 63 43
82E8: 1C 1C 1C 63 63 1C 1C 1C 9C
82F0: 03 1F 1C 63 63 1C 1C 1C D8
82F8: 1C 1C 1C 63 1F 1F 1F 1F 9F
8300: 1F 1F 1C 63 63 1C 1C 1C F7
8308: 1C 10 44 13 1C 1C 1C 60 C4
8310: 1C 1C 1C 1C FF FF 00 00 71
```

"Solitaire" for TI-99/4A computers.

Program 6: TI-99/4A Solitaire

Version by Patrick Parrish, Programming Supervisor

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
100 DIM P(4,13),D(52),T(52)
110 CALL SCREEN(16)
120 GOTO 170
130 FOR I7=1 TO LEN(H$)
140 CALL HCHAR(RDW,COL+I7,A
    SC(SEG$(H$,I7,1)))
150 NEXT I7
160 RETURN
170 CALL CLEAR
180 PRINT TAB(10);"SOLITAIR
    E":::::::::
190 GOSUB 2780
200 F5=1
210 C=52
220 W=1
230 RANDDMIZE
240 GOSUB 1760
250 H$="...SHUFFLING"
260 ROW=24
270 COL=9
280 GOSUB 130
290 GOSUB 1920
300 CALL HCHAR(24,10,32,12)
310 H$="...DEALING"
320 GOSUB 130
330 FOR I=1 TO 4
340 FOR J=1 TO 13
350 GOSUB 2110
360 NEXT J
370 NEXT I
380 CALL HCHAR(24,10,32,10)
390 GOSUB 2300
400 GOSUB 3010
410 IF W<>5 THEN 470
420 W=1
430 F1=0
440 GOSUB 2450
450 IF F1<>0 THEN 470
460 GOTO 1200
470 I=INT((E(W)-1)/13)+1
480 J=E(W)-13*INT((E(W)-1)/
    13)
490 IF J=1 THEN 540
500 LL=P(I,J-1)
510 IF (LL<>1)*(LL<>14)*(LL
    <>27)*(LL<>40)*(LL/13<>
    INT(LL/13))THEN 540
520 W=W+1
530 GOTO 410
540 N$="v"
550 S$=" "
560 GOSUB 2250
570 CALL KEY(0,KK,SS)
580 IF SS<>0 THEN 660
590 N$=" "
600 GOSUB 2250
610 CALL KEY(0,KK,SS)
620 IF SS<>0 THEN 660
630 N$="v"
640 GOSUB 2250
650 GOTO 570
660 IF KK=80 THEN 720
670 IF KK<>77 THEN 570
680 N$=" "
690 GOSUB 2250
700 W=W+1
710 GOTO 410
720 IF J=1 THEN 900
730 LL=P(I,J-1)
740 IF (LL/13=INT(LL/13))+(
    LL=1)+(LL=14)+(LL=27)+(
    LL=40)THEN 570
750 TE=P(I,J)
760 TT=T(P(I,J))
770 L=T(P(I,J-1)+1)
780 T(P(I,J))=T(P(I,J-1)+1)
790 T(P(I,J-1)+1)=TT
800 P(I,J)=P(INT((L-1)/13+1
    ),L-13*INT((L-1)/13))
810 P(INT((L-1)/13)+1,L-13*
    INT((L-1)/13))=TE
820 GOSUB 2110
830 I=INT((L-1)/13)+1
840 J=L-13*INT((L-1)/13)
850 GOSUB 2110
860 GOSUB 2300
870 W=1
880 GOTO 410
890 REM  OFFER CHOICE OF TW
    O'S
900 CALL HCHAR(23,1,32,64)
910 H$="WHICH '2' YOU WANT
    TO PLACE?"
920 ROW=23
930 COL=1
940 GOSUB 130
950 H$="TWD OF 'S','H','D',
    OR 'C' ?"
960 ROW=24
970 GOSUB 130
980 CALL KEY(0,KK,SS)
990 IF KK<>83 THEN 1020
1000 N2=2
1010 GOTO 1110
1020 IF KK<>72 THEN 1050
1030 N2=15
```

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```
1040 GOTO 1110
1050 IF KK<>68 THEN 1080
1060 N2=28
1070 GOTO 1110
1080 IF KK<>67 THEN 980
1090 N2=41
1100 REM  EXCHANGE LOCATION
     S
1110 TE=P(I,J)
1120 TT=T(P(I,J))
1130 L=T(N2)
1140 T(P(I,J))=T(N2)
1150 T(N2)=TT
1160 CALL HCHAR(23,1,32,64)
1170 GOSUB 3010
1180 GOTO 800
1190 REM  PLAYER CAN NO LON
     GER MOVE SO ERASE THE
     WRONG ENTRIES, RESHUFF
     LE, & OEAL
1200 FOR I=1 TO 4
1210 N(I)=0
1220 IF (P(I,1)<>2)*(P(I,1)
     <>15)*(P(I,1)<>28)*(P(
     I,1)<>41)THEN 1300
1230 N(I)=1
1240 FOR J=2 TO 12
1250 IF P(I,J)-1=P(I,J-1)TH
     EN 1280
1260 J=14
1270 GOTO 1290
1280 N(I)=N(I)+1
1290 NEXT J
1300 NEXT I
1310 IF (N(1)=12)*(N(2)=12)
     *(N(3)=12)*(N(4)=12)TH
     EN 2560
1320 F5=F5+1
1330 REM  ERASE THE WRONG E
     NTRIES
1340 CALL HCHAR(23,1,32,60)
1350 N$=" "
1360 S$=" "
1370 H$="...RESHUFFLING"
1380 ROW=24
1390 COL=9
1400 GOSUB 130
1410 FOR I=1 TO 52
1420 O(I)=I
1430 NEXT I
1440 FOR I=1 TO 4
1450 FOR J=N(I)+1 TO 13
1460 GOSUB 2250
1470 NEXT J
1480 NEXT I
1490 C3=52
1500 FOR I=1 TO 4
1510 IF N(I)=0 THEN 1550
1520 FOR J=1 TO N(I)
1530 O(P(I,J))=0
1540 NEXT J
1550 NEXT I
1560 FOR I=1 TO 4
1570 FOR J=1+N(I)TO 13
1580 RANDOMIZE
1590 R1=INT(RND*C3+1)
1600 IF O(R1)<>0 THEN 1640
1610 O(R1)=D(C3)
1620 C3=C3-1
1630 GOTO 1590
1640 P(I,J)=O(R1)
1650 O(R1)=O(C3)
1660 C3=C3-1
1670 NEXT J
1680 NEXT I
1690 FOR II=1 TO 52
1700 T(II)=0
1710 NEXT II
1720 GOSUB 2040
1730 CALL HCHAR(24,10,32,14
     )
1740 GOTO 310
1750 REM  ORAW BOXES
1760 PRINT " ** **  ** **
     ** **  ** **"
1770 FOR J=1 TO 6
1780 FOR I=1 TO 2
1790 PRINT "a  e  ba  e  ba
       e  ba  e  b"
1800 NEXT I
1810 PRINT " dd dd  dd dd
     dd dd  dd dd"
1820 NEXT J
1830 PRINT ::::
1840 FOR I=0 TO 3
1850 CALL HCHAR(19,7+I*7,99
     ,2)
1860 CALL VCHAR(20,3+I*7,97
     ,2)
1870 CALL HCHAR(22,4+I*7,99
     ,2)
1880 CALL VCHAR(20,6+I*7,98
     ,2)
1890 NEXT I
1900 RETURN
1910 REM  SET UP DECK
1920 FOR I=1 TO 52
1930 O(I)=I
1940 NEXT I
1950 FOR I=1 TO 4
1960 FOR J=1 TO 13
1970 RANDOMIZE
1980 R1=INT(RND*C+1)
1990 P(I,J)=O(R1)
2000 O(R1)=O(C)
2010 C=C-1
2020 NEXT J
2030 NEXT I
2040 FOR II=1 TO 4
2050 FOR JJ=1 TO 13
2060 T(P(II,JJ))=(II-1)*13+
     JJ
2070 NEXT JJ
2080 NEXT II
2090 RETURN
2100 REM  SHOW CARD P(I,J)
2110 S$="ytux"
2120 H5=INT((P(I,J)-1)/13)+
     1
2130 S$=SEG$(S$,H5,1)
2140 N8=P(I,J)-(H5-1)*13
2150 IF N8<>1 THEN 2170
2160 S$=" "
2170 IF (H5=1)+(H5=4)THEN 2
     200
2180 N1$=" hijklmnopqrs"
2190 GOTO 2210
2200 N1$=" 23456789QJQK"
2210 N$=SEG$(N1$,N8,1)
2220 GOSUB 2250
2230 RETURN
2240 REM  PLACE N$;S$ AT PO
     SITION I,J
2250 J5=J+(J>7)*7
2260 CALL HCHAR(J5*3,(I-1)*
     7+4-(J>7)*3,ASC(N$))
2270 CALL HCHAR(J5*3-1,(I-1
     )*7+5-(J>7)*3,ASC(S$))
2280 RETURN
2290 REM  FIND FIRST FOUR E
     MPTY BOXES
2300 Z=1
2310 FOR I=1 TO 52 STEP 13
2320 E(Z)=T(I)
2330 Z=Z+1
2340 NEXT I
2350 FOR J=1 TO 4
2360 FOR I=1 TO 3
2370 IF E(I)<=E(I+1)THEN 24
     10
2380 AA=E(I)
2390 E(I)=E(I+1)
2400 E(I+1)=AA
2410 NEXT I
2420 NEXT J
2430 RETURN
2440 REM  CHECK TO SEE IF A
     LL FOUR SPACES FOLLOW
     A KING OR BLANK
2450 FOR K=1 TO 4
2460 X=INT((E(K)-1)/13+1)
2470 Y=E(K)-13*INT((E(K)-1)
     /13)
2480 IF Y<>1 THEN 2500
2490 F1=1
2500 W2=P(X,Y-1)
2510 IF (W2=1)+(W2=14)+(W2=
     27)+(W2=40)+(W2/13=INT
     (W2/13))THEN 2530
2520 F1=1
2530 NEXT K
2540 RETURN
2550 REM  ALL OONE
2560 H$="CONGRATULATIONS!!
     YOU WON!!"
2570 CALL HCHAR(23,1,32,64)
2580 ROW=23
2590 COL=2
2600 GOSUB 130
2610 H$="IT TOOK YOU "&STR$
     (F5)&" TRIES."
2620 ROW=24
2630 COL=5
2640 GOSUB 130
2650 CALL HCHAR(23,1,32,32)
2660 H$="PLAY AGAIN (Y/N)?"
2670 ROW=23
2680 COL=8
2690 GOSUB 130
2700 CALL KEY(0,KK,SS)
2710 IF SS=0 THEN 2700
2720 IF KK<>89 THEN 2750
2730 CALL CLEAR
2740 GOTO 200
2750 IF KK<>78 THEN 2700
2760 END
2770 REM  REDEFINE CHARS
2780 FOR I=96 TO 101
2790 READ A$
2800 CALL CHAR(I,A$)
2810 NEXT I
2820 DATA 00000000000000FF,
     0101010101010101,80808
     0808080808
2830 DATA FF0000000000000,
     FF0000000000FF,81818
     1818181818
2840 FOR I=104 TO 118
2850 READ A$
2860 CALL CHAR(I,A$)
2870 NEXT I
2880 DATA 003844404081207C,
     003844041804443B,00081
     828487C0808
2890 DATA 007C407804044438,
     0018204078444438,007C0
     40810202020
2900 DATA 003844443B444438,
     003844443C040830,003B4
     4444444443B
2910 DATA 0004040404044438,
     003844444454483A,00444
     85060504844
2920 DATA 00367F7F3E1C0800,
     00183C7E7E3C1800,FFFFF
     FFFFFFFFF
2930 CALL COLOR(10,7,1)
2940 CALL COLOR(11,7,1)
2950 FOR I=120 TO 121
2960 READ A$
2970 CALL CHAR(I,A$)
2980 NEXT I
2990 DATA 001C1C7777081C00,
     00183C7E7E183C00
3000 RETURN
3010 H$="<M>OVE TO NEXT EMP
     TY SLOT"
3020 ROW=23
3030 COL=3
3040 GOSUB 130
3050 H$="<P>LACE A CARD AT
     CURSOR"
3060 ROW=24
3070 GOSUB 130
3080 RETURN
```

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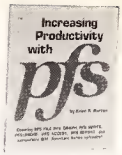

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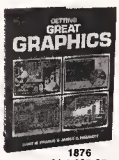

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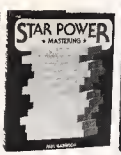

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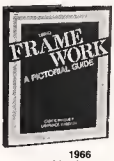

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SpeedCalc

For Commodore 64 And 128

Kevin Martin

In response to popular request, COMPUTE! *presents this high-quality spreadsheet program for the Commodore 64 and 128 (in 64 mode). Written completely in machine language,* SpeedCalc *has the major features you'd expect from a commercial spreadsheet. In addition, its data files can be merged into text files created with the* SpeedScript *word processor published last year in* COMPUTE!. SpeedCalc *requires a disk drive; a printer is recommended. Upcoming issues of* COMPUTE! *will feature versions of* SpeedCalc *for Apple II-series computers (DOS 3.3 and ProDOS) and Atari 400/800, XL, and XE computers.* SpeedCalc *also will be available on the premiere* COMPUTE! DISK *editions for Commodore, Apple, and Atari computers.*

Have you ever planned a budget for your home or office? If so, you probably used some sort of worksheet divided into rows and columns. Perhaps you wrote the months of the year along the top of the sheet and listed categories for earnings and expenses along one side. After entering data for each category and month of the year, you could calculate total income figures by adding or subtracting numbers in each of the sheet's "cells."

That's a classic example of a worksheet. It lets you enter and organize data, then perform calculations that produce new information. A *spreadsheet* program is an electronic version of the familiar paper worksheet. Since it does all the calculations for you at lightning speed, an electronic spreadsheet is far more convenient than its paper counterpart. And spreadsheet programs also offer built-in editing features that let you enter and manipulate large amounts of data with a minimum of effort.

SpeedCalc is an all machine language spreadsheet program for the Commodore 64. Though relatively compact in size, it's fast and easy to use, and has many of the features found in commercial spreadsheet programs. Even better, the "*SpeedScript* Integrator" program (also included here) lets you merge your *SpeedCalc* files into word processing documents created with *SpeedScript*, COMPUTE!'s popular word processor (see COMPUTE!, March 1985, or *SpeedScript for the Commodore 64*, published by COMPUTE! Books). Working together, *SpeedCalc* and *SpeedScript* make a powerful team. You can merge a chart of sales figures into a company report, create a table of scientific data for a term paper, and manipulate numeric information in many other ways. In a sense, a spreadsheet program brings to arithmetic all of the flexibility and power that a word processor brings to writing.

Preparing The Program

Although *SpeedCalc* is small in comparison to similar commercial programs, it is the longest program COMPUTE! has ever published. Fortunately, the new "MLX" machine language entry utility makes it easier to type a program of this size. Be sure to carefully read the new MLX article elsewhere in this issue before you begin. Since this latest version of MLX was first introduced in last month's issue, you'll need to read the new article even if you've used the old MLX many times

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before. *The* SpeedCalc *programs must be entered with the current version of MLX.*

Here are the addresses you need to enter *SpeedCalc* with MLX:

Starting address: 0801
Ending address: 2680

Be sure to save the program at least once before running it for the first time. Though it's written in machine language, *SpeedCalc* has been designed to load and run just like a BASIC program. Simply enter LOAD"*program name*",8 then type RUN.

The *SpeedCalc* Screen

SpeedCalc uses the top line of the screen as the *command line*. This is where *SpeedCalc* displays messages and asks you questions.

Screen lines 2–4 are the *input buffer* area. This is the work area where you enter and edit data. As you'll see in a moment, the input buffer also displays the data contained in the current cell.

The lower 21 screen lines are your window into the spreadsheet. Though the spreadsheet contains many rows and columns, only a few can fit on the screen at a time. By scrolling the screen back and forth with the cursor, you can move the display window to any part of the spreadsheet.

The *SpeedCalc* worksheet consists of 50 vertical columns labeled with letters (AA, AB, AC, ... BX) and 200 horizontal rows numbered from 1–200. The intersection of a row and column is called a *cell*. Cells are where you store data. With 50 columns and 200 rows, the *SpeedCalc* spreadsheet has a maximum of 10,000 (50*200) cells. Due to memory limitations, however, only about a third of these can actually contain data. But you may spread out the data over all 10,000 cells if necessary, depending on the format you need.

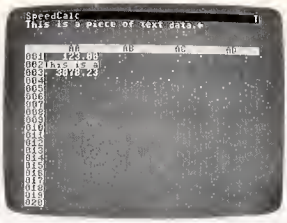
If you don't like the spreadsheet's screen colors, they're easily changed with the special function keys. Press the f1 key to cycle through the 16 border colors until you find one you like. The f3 key changes the background color and f5 changes the character color.

Moving The Cursor

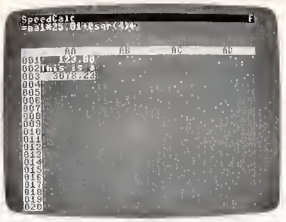
Each cell is identified with the letters of its column and the number of its row. For example, the cell at the extreme upper-left corner of the sheet is called AA1, since it's in column AA and row 1. The cell below that is AA2. Moving one cell to the right from AA2 puts you in cell AB2, and so on. (For the sake of clarity, this article uses uppercase letters for cell names. Note, however, that you must use lowercase letters such as *aa1* when entering cell names within *SpeedCalc*.)

Your current position in the spreadsheet is shown by the highlighted cursor. The simplest way to move around the sheet is with the cursor keys, which work just as they do in BASIC. Another way to move the cursor is with the HOME key (press CLR/HOME *without* pressing SHIFT). Press HOME once to "home" the cursor on the current screen; the cursor moves to the upper-left cell. Press HOME twice in succession to move the cursor to cell AA1, the home position for the entire sheet.

SpeedCalc also has a *goto* command for moving over long distances. Press CTRL-G (hold down CTRL and press G). The command line turns blue and displays GOTO: followed by an underline cursor. The underline cursor generally indicates that *SpeedCalc* is waiting for data—in this case it expects the name of the cell where you wish to go. If you enter ba188 at this point, *SpeedCalc* moves the cursor to cell BA188, adjusting the screen window as needed. Take a few moments to practice moving around the spreadsheet with all three methods—you'll be using them a lot. In a later section, we'll discuss how to change the size and format of a cell.



A typical screen from Commodore 64 SpeedCalc*—a compact, powerful spreadsheet program written entirely in machine language.*



SpeedCalc's *input buffer always displays the contents of the data cell under the highlighted cursor.*

Keyboard Commands

SpeedCalc offers many different commands, a few of which are entered by pressing one key. However, most commands are entered by pressing CTRL along with another key. CTRL-G, as you've seen, is the goto command. CTRL-A displays the amount of free memory available, and so on. The most drastic command is CTRL-X, which exits *SpeedCalc* and returns you to BASIC. Since leaving the program effectively erases all data in memory, *SpeedCalc* asks ARE YOU SURE Y/N? before shutting down. To cancel the command and return to the spreadsheet, type N and press RETURN.

A few commands require you to press three keys at once. This sounds more awkward than it is in practice, since two of the three keys are SHIFT and CTRL. For instance, the command to switch between automatic and manual recalculation is performed by pressing SHIFT-CTRL-R (hold down SHIFT and CTRL, then press R). The accompanying table lists all the *SpeedCalc* commands, and the figure shows the keyboard layout with a description of what each key does. We'll be discussing each command in more detail below.

Three Data Types

Before entering any data, you must know what kind of data *SpeedCalc* accepts. There are three different types: numbers, text, and formulas. Let's look at each type in turn:

1. **Numeric data** consists of numbers—the basic stuff that spreadsheets work with. *SpeedCalc* has a few simple rules for numeric data:

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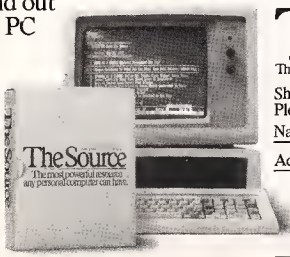

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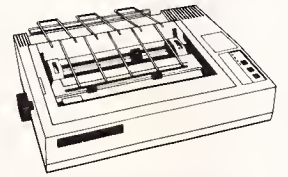

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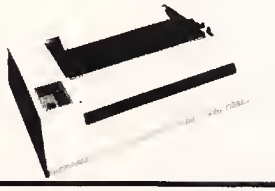

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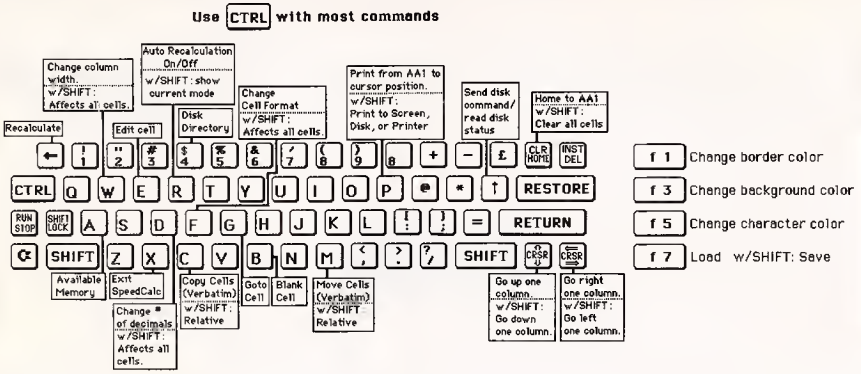

A number must be a decimal value (base 10, not hexadecimal) composed of one or more digits from 0–9, with an optional plus or minus sign. A decimal point is also optional. If you include any other characters in numeric input, *SpeedCalc* treats the entire input as text data (as explained below). Thus, the numbers 123, .001, and −65535 are valid numeric data. The numbers 65,535 (which includes a comma) and 312 Main Street are treated as text labels.

For example, let's enter the number 123 in cell AA1. No special commands are required to enter data: Just move the cursor to AA1 and begin typing. While you're entering the number, it appears only in the input buffer near the top of the screen. As soon as you press RETURN, the number appears in AA1 and the letter N appears at the upper-right of the screen. The N signifies *numeric*, meaning that *SpeedCalc* has accepted the entry as valid numeric data. Move the cursor to a vacant cell, then move it back to AA1. The input buffer displays whatever data is found in the cell under the cursor. When the current cell is empty, the buffer is empty as well.

As you can see, pressing RETURN enters a data item into the current cell. You can also end the input by pressing a cursor key. The data is entered as if you had pressed RETURN, and the cursor moves in the indicated direction. This feature is handy for entering a lot of data: Simply type the entry, move the cursor to the next cell, enter more data, and so on.

SpeedCalc Commands

Command	Action
CTRL-A	available memory check
CTRL-B	blank (erase) current cell
CTRL-C	copy block verbatim
CTRL-D	set number of decimals
CTRL-E	edit current cell
CTRL-F	change cell format
CTRL-G	goto selected cell
CTRL-M	move block verbatim
CTRL-P	print sheet
CTRL-R	turn on/off auto recalculation
CTRL-W	change column width
CTRL-X	exit *SpeedCalc*
CTRL-4	disk directory
CTRL-↑	send disk command
CLR/HOME	home cursor
SHIFT-CTRL-C	copy block relative
SHIFT-CTRL-D	change decimal mode for all cells
SHIFT-CTRL-M	move block relative
SHIFT-CTRL-P	print to screen, disk, or printer
SHIFT-CTRL-R	display current recalculation mode
SHIFT-CTRL-W	change width of all columns
SHIFT-CLR/HOME	erase entire sheet
f1	change border color
f3	change background color
f5	change character color
f7	load *SpeedCalc* file
f8	save *SpeedCalc* file
←	recalculate sheet

2. Text data is not "data" in the strict sense, since *SpeedCalc* doesn't use it in calculations as it does numbers and formulas. Text data is there only to help humans understand what the other data means. Text may consist of comments, titles, column headings, subheadings, or whatever you need to interpret the numbers and formulas. As an example, move the cursor to cell AA2 (just under AA1) and type the following line. Note that both uppercase and lowercase letters are acceptable:

This is some text data.

You can use the DEL key to erase mistakes while you're typing. When you press RETURN, *SpeedCalc* displays T (for text) in the upper-right corner. In this example, the cell isn't long enough to accept all the text, so only the leftmost portion appears in AA2. But even

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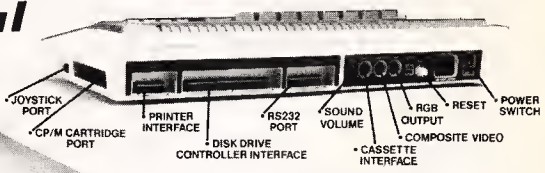

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4 Voice, 6 Octove Sound	**Yes**	No	Yes
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though you can't see all the text, it's there. Move the cursor to another cell, then move it back to AA2. As soon as you return to AA2, *SpeedCalc* displays all the text in the input buffer.

3. Formula data is a mathematical expression or formula. It may be as simple as 2+2 or as complex as your imagination (and mathematical prowess) allows. The first character in a formula must always be an equal sign (=). If you omit this symbol, *SpeedCalc* either signals an error or treats the data as text. The true power of a spreadsheet is that a formula in one cell can refer to another cell. This is easier to demonstrate than to explain. Move the cursor to cell AA3 and type the following line:

```
=aa1*25.01+@sqr(4)
```

As soon as you press RETURN, *SpeedCalc* displays F (for formula) in the upper-right corner and puts the *result* of the formula (not the formula itself) in AA3. If AA1 contains 123, the value 3078.23 appears in AA3. In plain English, this formula means "multiply the contents of cell AA1 by 25.01 and add the square root of 4." Before we examine the formula more closely, here's a quick demonstration of what makes a spreadsheet such a powerful tool. Move the cursor back to AA1 and press CTRL-R. The command line displays the message RECALCULATION IS ON, meaning *SpeedCalc* now automatically recalculates the entire sheet whenever you make a change. Now change the number in AA1 to 456 (simply move to the cell and start typing). The new result (11406.53) automatically appears in cell AA3. We'll explain more about automatic recalculation later.

When you enter the name of another cell in a formula, the letters must be lowercase (enter *aa1*, not *AA1*). The referenced cell must contain data that *SpeedCalc* can evaluate: a number or another formula. If the formula refers to an empty cell, or one that contains text, *SpeedCalc* signals an error.

Mathematical Operators

These symbols can be used as *operators* in a formula:

Operator	Function
+	addition
−	subtraction
*	multiplication
/	division
↑ (up arrow)	exponentiation
=	equality

One factor that affects formulas is *precedence*, or the order in which mathematical operations are performed. In *SpeedCalc*, formula operators have the same precedence as BASIC—the same as in general math.

The first operators to be evaluated—those with the highest precedence—are those enclosed in parentheses. Where one set of parentheses encloses another, the expression in the innermost set is evaluated first. The next operators to be evaluated are exponents. Multiplication and division have equal precedence; both operations are lower than exponentiation. Addition and subtraction have the lowest precedence of all. The mnemonic "My Dear Aunt Sally" (MDAS—Multiplication, Division, Addition, Subtraction) is a reminder of mathematical precedence.

To take one example, *SpeedCalc* evaluates the formula =5*(8+3*−2)↑2−10/+2 as the value 15, just as in ordinary math. Note how the result is affected by the plus and minus signs before the 2's.

Functions

Formulas may also include any of the functions listed here:

@abs( )	absolute value
@atn( )	arctangent
@ave( )	average of a block of cells [form: @ave(xxn:xxn)]
@cos( )	cosine of argument in radians
@exp( )	complement of log, gives e^x (e=2.7182318...)
@int( )	integer (rounds to next lowest whole number)
@log( )	natural logarithm base e (log of zero or a negative number is illegal)
@sgn( )	sign (−1 for negative numbers, 0 for 0, 1 for positive)
@sin( )	sine of argument in radians
@sqr( )	square root (root of a negative number is illegal)
@sum( )	sum of a block of cells [form: @sum(xxn:xxn)]
@tan( )	tangent of argument in radians. @tan(.5*pi) is illegal
pi	value of pi (3.14159265)

All the functions except pi begin with the @ symbol and are followed by parentheses. Within the parentheses of a function you may use a number or formula. For example, the formula =@sqr(4) generates the square root of 4. The formula =@sqr(aa1) returns the square root of whatever value cell AA1 contains. Note that the *argument* (value within parentheses) of the functions @tan( ), @sin( ), and @cos( ) must be expressed in radians; the result of the function @arc( ) is expressed in radians.

The function @int( ) generates an integer (whole number) by rounding to the next lowest whole number. For positive numbers, this is equivalent to dropping the fraction, but for a negative number like −4.3, the next lowest number is actually −5.

The function @ave( ) calculates the mean average of the values in a block (group) of cells. The function @sum( ) calculates the sum of a block. Both functions require that you define the block so that *SpeedCalc* knows which cells to include in the calculation. This is done by putting two cell names separated by a colon in the parentheses. The first cell name defines the upper-left corner of the block, and the second defines the bottom-right corner. For instance, @ave(aa1: ad20) calculates the average of all the cells from AA1 to AD20. The function @sum(aa1:ad20) calculates the sum of AA1 through AD20, and so on. An error results if any cell in the block is blank or contains text data.

Math Notes

SpeedCalc uses the same ROM routines for math as BASIC. Therefore, it follows almost the same rules and has the same limitations. Numbers are accurate internally to only nine digits—although you can enter long numbers and view them exactly as you entered them, only the first nine digits are used for calculations. If you enter a very long number (more than 36 digits), your input is ignored, and the cell reverts to its former state. You can also enter long numbers in the form 1.23E+05 (scientific notation). Note, however, that *SpeedCalc* itself never uses scientific notation. It converts all numbers to their full length, so long numbers actually use more memory than shorter ones.

Beware of math errors such as division by zero, square root of a negative number, tangent of pi/2, logarithm of zero or a negative

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number, and overflow conditions like 2↑300. *SpeedCalc* detects these errors and displays *ERROR* in the cell of an illegal calculation.

Editing The Sheet

Editing is a very important spreadsheet function. The simplest way to change what a cell contains is to move to it and start typing. The old data in that cell is replaced by whatever you enter. For instance, to replace the contents of cell AA1 with the number 456, move to that cell, type 456, and press RETURN or exit with a cursor key.

Press CTRL-B (think of *blank*) to erase what's in the current cell. You can also clear a cell by typing a space and pressing RETURN, but this uses some memory. A truly blank cell doesn't use any memory.

To erase everything in the sheet, press SHIFT–CLR/HOME. Before carrying out this drastic operation, *SpeedCalc* asks you to confirm it by pressing Y or N.

In some cases, only a minor change is needed. *Edit mode* lets you change the data in a cell without retyping the entire entry. To activate edit mode, move to the desired cell and press CTRL-E. In this mode, the up/down cursor key is disabled, and the left/right cursor key moves within the input buffer. Erase unwanted characters with the DEL key. Typing in edit mode inserts new characters in the line: Everything to the right of the new character moves right one space (unless the buffer is already full). Since the cursor keys have a different function in edit mode, you cannot use them to end the input. Press RETURN to enter the new data and escape from edit mode.

As you may have learned already, *SpeedCalc* displays *ERROR* in a cell when you enter an erroneous formula. The usual cause is that you have made a typing error in that cell, or the formula refers to text or an empty cell. A line of asterisks (*********) signals that a number is too large to be printed in the cell. Though these messages appear in the cell area, no data is lost. You may move to the affected cell, view its contents in the input buffer, and make whatever correction is needed.

Recalculation

The recalculation feature is the very core of *SpeedCalc*. As you know, entering or editing a piece of data causes *SpeedCalc* to perform a calculation and put the result in the cell under the cursor. In most cases, the new data relates to data in other cells, so you'll ultimately want to recalculate the entire spreadsheet as well. This can be done in two different ways: manually or automatically.

To recalculate the spreadsheet manually, press the back arrow key (←, at upper-left on the keyboard). *SpeedCalc* begins at AA1 and recalculates every cell that contains data, placing fresh results wherever needed. *SpeedCalc* displays the message RECALCULATING while it's busy.

If you switch to automatic recalculation mode, *SpeedCalc* automatically recalculates the entire spreadsheet each time you enter new data or edit what exists. When you press CTRL-R, *SpeedCalc* changes the recalculation status and displays it at the top of the screen. If automatic recalculation was turned off before, it is now on (and vice versa). If you aren't sure which mode you're in, press SHIFT-CTRL-R; *SpeedCalc* displays the recalculation mode without changing it.

Automatic recalculation can be fun to watch in a large spreadsheet: Every time you make a change, new results ripple all the way down the screen. However, the more data your spreadsheet contains, the longer it takes to update the entire sheet. For this reason, you may want to turn automatic recalculation off most of the time, recalculating with the back arrow key whenever you need to view results.

One problem with recalculation arises from the order in which cells are calculated. Because only one cell can be calculated at a time, you must sometimes recalculate the entire spreadsheet two or three times to get correct results in every cell (this is common to all spreadsheet programs). For instance, say you have a formula in AA1 which refers to a formula in AB15. When *SpeedCalc* calculates AA1, it must use the existing data from AB15—which is probably out of date, since the formula in AB15 hasn't been recalculated yet. To avoid this problem, you should always press the back arrow key two or three times before printing a spreadsheet or saving it to disk.

SpeedCalc offers a number of other features. Before experimenting with them, you should spend some time typing in a hypothetical spreadsheet—perhaps a fictitious yearly budget—to become thoroughly familiar with the basic commands covered so far. Most importantly, create formulas, using all the operators in different combinations. Try doing things that you know will cause errors. Then correct the errors in edit mode, and so on. It takes a thorough grasp of the fundamentals to get the most out of *SpeedCalc*'s advanced features.

Change Type And Format

The default (normal) format for numeric data is flush right with rounding to two decimal places. In other words, the number is displayed in the rightmost part of the cell, with two numbers after the decimal point. Text and formulas are flushed left (shown in the leftmost part of the cell). *SpeedCalc* offers several commands for changing cell formats.

Change Format (CTRL-F). This command changes the location of data in the cell and the number of decimal places. When you press CTRL-F, *SpeedCalc* displays the question FORMAT: Left, Center, or Right justify? in the command line. Press L, C, or R to move the data to the left, center, or right of the cell.

Change number of decimal places (CTRL-D). This command lets you specify the number of digits displayed after the decimal point. The default value is 2, convenient for dollar amounts, but you may change it to anything from 0–15. If you choose zero decimal places, any number in that cell is rounded off to the nearest integer (whole number). A setting of 15 is special: The number in that cell is not rounded off at all. Instead, *SpeedCalc* displays the number exactly as you entered it or as it was calculated from a formula. Watch out for one feature of CTRL-D: It also resets the cell to right justification, so you may need to change this with CTRL-F.

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Width (CTRL-W). The width command changes the width of an entire column of cells. Move the cursor to any cell in the desired column, then press CTRL-W. When *SpeedCalc* displays the prompt Width: you should respond with a number from 4–36. The entire screen is redrawn to accommodate the new format, and may look very different depending on what value you choose. For instance, if you increase a column's width, the rightmost column of the former display may disappear: *SpeedCalc* only displays as many complete columns as it can fit on the screen. If you decrease the width of a column, you may see asterisks where numbers used to be (indicating the cell is now too small to display the entire number). To get rid of the asterisks, expand the column as necessary.

Global Format (SHIFT-CTRL-F). This is the same as the ordinary format command, but operates globally, changing every cell in the sheet instead of just one. To alert you to the difference, *SpeedCalc* changes the color of the command line to blue.

Global Width (SHIFT-CTRL-W). This is a global version of the width command. The command line turns light green to signal the difference. Every column in the sheet changes to the designated width.

Global Decimal (SHIFT-CTRL-D). This command lets you change the number of decimals displayed for the entire sheet. The default for the sheet is two decimal places. Every cell changes to the designated setting, and the new setting becomes the default for future entries.

Macroediting

After typing in a large spreadsheet, you may decide to make a major change. You may want to add new data somewhere in the middle, delete a section, or move a group of cells from one location to another. *SpeedCalc*'s macroediting (large-scale editing) commands simplify such operations, affecting an entire block of cells at once. A *block* is simply a group of cells connected in rectangular fashion: You can define it as a single cell, a row or column, or any rectangular area within the spreadsheet.

There are two ways in which macro commands can work: *verbatim* or *relative*. To take a simple example, say that cell AA2 contains the formula =aa1*5 and you want to move its contents to cell AB2. When this is done in verbatim mode, AB2 contains an exact copy of what was in AA2 (=aa1*5). Note that the cell name used in the formula does not change: The formula still refers to AA1. If you perform the same operation in relative mode, the cell name in the formula is adjusted to fit the new location. In this case, AB2 would contain the formula =ab1*5.

Copy (CTRL-C). The copy command copies a block of cells into a different location without disturbing the original cells. Place the cursor on the upper-left corner of the block you want to copy, then press CTRL-C. *SpeedCalc* changes the command line to purple and prompts you to move the cursor to the lower-right corner of the block you want to copy. Once the cursor is in place, press RETURN. Now *SpeedCalc* prompts you to move the cursor to the place where you want to put the block: This is the upper-left corner of the new position. Once the cursor is there, press RETURN again. The new data replaces whatever was contained in the designated cells. Note that if you define an impossible block (for instance, moving the cursor to the upper-left of the original position, rather than below and to the right), *SpeedCalc* does not copy any data. You can use this trick to escape from Copy if you press CTRL-C accidentally. Another escape is to press RETURN twice while the cursor remains on the original cell.

Move (CTRL-M). This command works like a copy, but it fills the original cells with blanks. Though *SpeedCalc* has no insert command, you can use this command to make space for new data in the middle of a spreadsheet. Simply move everything below the insertion point down as far as you need. To cancel this command, press RETURN twice while the cursor is on the same cell.

Relative Copy (SHIFT-CTRL-C). This form of the copy command adjusts the cell names used in formulas within the copied block (see explanation above).

Relative Move (SHIFT-CTRL-M). This is the relative form of the move command. Cell names in formulas are adjusted to reflect the move.

Memory Management

SpeedCalc leaves 10,752 bytes of memory (10.5K) available for data. As noted earlier, *SpeedCalc* lets you spread your data out over a much larger number of cells than you can actually fill with data. The extra space is provided to give you full control over the final format of the spreadsheet—for example, you could have a 15 × 150 spreadsheet—and to leave some elbow room for move and copy operations.

Because memory is limited, you should keep careful track of how much is free while using the program. Press CTRL-A to display the amount of free memory. We suggest limiting your spreadsheets to 1,296 cells (equivalent to 36 rows by 36 columns). If you have filled nearly all of free memory, you may have to break the spreadsheet into two smaller sheets.

Although *SpeedCalc* checks the amount of available memory, and displays an error message if you run out of memory, you should be careful not to exhaust free memory. Any move or copy operation in process will be aborted if sufficient memory is not available.

Disk Operations

SpeedCalc has four disk commands which allow you to save a spreadsheet to disk, load it, display the disk directory, and send commands to the disk drive. The directory command is the simplest to use. Press CTRL-4 (think of the dollar sign, as in LOAD "$",8 to list the directory from BASIC): The screen clears and the directory is displayed. Press RETURN to return to the normal screen. You may pause the directory display with the space bar.

To save a spreadsheet to disk, press the f8 function key (SHIFT-f7). *SpeedCalc* prints SAVE: on the command line, followed by an underline cursor. Enter a valid Commodore filename and press RETURN. (If you change your mind and decide not to save anything, press RETURN without typing a filename.) The disk drive spins for a

few moments, then *SpeedCalc* prints the drive status in the command line. The message 00,OK,00, 00 means there were no errors.

To load a saved file from disk, press the f7 key. Again, *SpeedCalc* prompts you to enter the filename and displays the disk status when the operation is complete. *SpeedCalc* files are saved as PRG (program) file types, but do not load as normal program files. *SpeedCalc* uses special header bytes to identify a *SpeedCalc* file. If you try to load anything other than a valid *SpeedCalc* file, you'll see the message NOT A SPEEDCALC FILE.

You can send Commodore disk commands to the drive with CTRL-↑—press CTRL and the ↑ (up-arrow) key together. *SpeedCalc* prompts you to enter a disk command. The CTRL-↑ command works much like the Commodore Wedge utility. If you press RETURN without typing a command, *SpeedCalc* displays the drive status and sends no command. You need not enclose the command in quotation marks or type ,8 after it. For example, press CTRL-↑, then enter I0 to initialize a disk. Consult your disk drive manual for more information about Commodore disk commands.

Printing

SpeedCalc lets you print data to three different devices: to the screen for previewing output, to a printer for permanent documentation, or to a disk file for integrating the data with another program.

To preview your spreadsheet on the screen, press SHIFT-CTRL-P, then press S (screen output) when prompted. Naturally, the display will look odd if your sheet is wider than 40 columns. Think of each pair of 40-column lines as one 80-column printed line.

To print a hardcopy of the spreadsheet, press CTRL-P. If your printer is configured like most, this should produce a satisfactory printout. This command sends output to the printer as device number four with a secondary address of seven (uppercase/lowercase on most systems). *Before using this command, you must position the cursor below and to the right of the block of cells you wish to print.* The upper-left corner of the printout starts at cell AA1. The entire width you define by this position is used. Therefore, don't try to print overly wide spreadsheets that won't fit on the paper. If you want to print a spreadsheet wider than 80 columns, many printers have a condensed mode that lets you fit 132 characters on a line. You can set this by switching an internal DIP switch, or by sending a CHR$ code from BASIC before running *SpeedCalc*. Many printers respond to this command for condensed mode: OPEN 4,4: PRINT#4,CHR$(15):CLOSE 4.

To send output to a printer with a device number other than four or a secondary address other than seven, enter SHIFT-CTRL-P, then enter the device number and secondary address when prompted. During a printout, you can pause the output by pressing SHIFT or SHIFT LOCK. The screen border turns white and printing ceases until you release SHIFT. Press RUN/STOP to abort printing.

You can also print *SpeedCalc* data to a disk file for use with terminal programs, databases, or word processors (including *SpeedScript*). Select the D option after pressing CTRL-SHIFT-P, then enter the filename you wish the new file to have. The data is saved as a SEQuential disk file of that name. The disk file is an exact Commodore ASCII image of what would go to the printer.

Note that *printing* to disk creates a different file than *saving* to disk: You should *save* files that you wish to reload into *SpeedCalc*, and *print* files that you wish to convert for *SpeedScript* or other programs. While you may pause this operation with SHIFT as with printer output, *do not use RUN/STOP to abort printing to disk.* This may create a "poison" (unclosed) file which can be safely removed only by validating the disk.

SpeedScript Integrator

SpeedCalc sends data to the printer in simple, plain-vanilla form. That may be fine for personal use, but if you're creating a document for others to view, you may want special features such as boldface, underlining, etc. Since *SpeedScript*—COMPUTE!'s popular word processor—already offers a way to access these features (and many more), no attempt has been made to include them in *SpeedCalc*. All that's needed is a simple program to convert *SpeedCalc* files into a form that *SpeedScript* can load. Then you can edit the file with *SpeedScript* as you would any other document—inserting printer control codes, reformatting the text, merging it with other text, and so on.

Type in and save Program 2, using MLX as you did with *SpeedCalc*. Enter 0801 as the MLX starting address and 0948 as the ending address. Like *SpeedCalc*, the *SpeedScript* Integrator loads and runs exactly like a BASIC program, even though it's written in machine language. Here are the steps to convert a *SpeedCalc* file for *SpeedScript*:

1. After creating a spreadsheet with *SpeedCalc*, print it to disk as described above.

2. Exit *SpeedCalc*, then load and run the Integrator. The program prompts you to enter the name of the *SpeedCalc* file you printed to disk. Then it asks you to enter the name of the *SpeedScript* file you want to create (of course, this name should be different from the first). The Integrator then constructs a *SpeedScript*-loadable disk file from the *SpeedCalc* file.

3. After the Integrator is finished, load and run *SpeedScript*, then load the new *SpeedScript* file as you would any *SpeedScript* document. The data appears on the screen, ready to be edited in any way you wish.

If you already have the *SpeedScript* File Converter published with the March 1985 *SpeedScript 3.0* article, you can use its Commodore ASCII to *SpeedScript* option to convert *SpeedCalc* files. This option works like the Integrator.

Program 1: *SpeedCalc* For Commodore 64

Please refer to the new "MLX" article in this issue before entering the following listing.

```
0801:0B 08 00 00 9E 32 30 36 EC
0809:31 00 00 00 A9 24 A0 5F 30
0811:A2 00 20 49 09 20 7F 0B DD
0819:20 E8 0A A9 26 18 69 01 B4
0821:8D 82 26 18 69 4F 85 30 A2
0829:A9 00 8D 81 26 8D 83 26 6C
0831:85 2F 8D 80 23 A9 A0 8D 18
0839:84 26 20 36 0B A9 00 8D 09
0841:86 02 A9 09 8D 01 03 A9 FA
0849:40 8D 00 03 20 E5 0D 20 DF
0851:E6 08 48 20 86 09 68 AE B9
0859:89 08 DD 89 08 F0 16 CA 7F
```

```
0861:D0 F8 C9 20 90 E6 C9 D8 E2
0869:B0 E2 C9 58 90 04 C9 C1 63
0871:90 DA 4C 96 0C CA 8A 0A 1E
0879:AA A9 08 48 A9 4C 48 BD 9B
0881:83 08 48 8D B2 08 48 60 F8
0889:1A 93 13 17 06 07 10 03 CE
0891:8C 88 18 11 91 1D 9D 02 5C
0899:05 5F 85 86 87 01 12 1E 9F
08A1:9F 0D 04 0D 31 32 33 34 03
08A9:35 36 37 38 39 30 2B 2D 5A
08B1:2E 1D 0B 33 12 69 10 07 12
08B9:0D A4 11 8A 14 73 16 45 24
08C1:1A 05 1B C2 1F 33 11 4C E3
08C9:11 63 11 8D 11 8A 1D C8 EB
08D1:1D F9 1C 30 09 21 09 FB 50
08D9:08 F0 1E 9D 1D ED 1B 5E FC
08E1:1C 54 16 4B 0D A5 C6 F0 0A
08E9:FC 8A 48 98 48 20 E4 FF 3A
08F1:8B BB 26 68 A8 68 AA AD EC
08F9:BB 26 60 EE 83 23 AD 83 F3
0901:23 29 0F 8D 83 23 A9 00 A5
0909:85 F3 A9 D8 85 F4 A0 28 07
0911:AD 83 23 91 F3 C8 D0 F8 B5
0919:E6 F4 A5 F4 C9 DC D0 F0 34
0921:60 EE 82 23 AD 82 23 29 88
0929:0F 8D 82 23 8D 21 D0 60 9B
0931:EE 84 23 AD 84 23 29 0F 2D
0939:8D 84 23 8D 20 D0 60 8A FF
0941:30 03 4C 62 23 4C 74 A4 B3
0949:85 FC 84 FB 8E 81 23 20 8E
0951:73 09 A9 13 20 D2 FF A0 B2
0959:00 B1 FB F0 06 20 D2 FF BC
0961:C8 D0 F6 60 A2 32 9D 88 92
0969:26 CA D0 FA A9 28 8D BB CF
0971:26 60 A0 00 A9 A0 99 00 C5
0979:04 AD 81 23 99 00 D8 C8 A2
0981:C0 28 D0 F0 60 AD 86 02 EF
0989:C9 0C F0 09 A9 24 A0 54 A5
0991:A2 00 20 49 09 38 20 BB AF
0999:20 90 03 4C 89 0F 4C 99 BF
09A1:0F 20 A9 0A 8D 28 04 A9 D7
09A9:1F 8D 29 04 A2 76 A9 20 76
09B1:9D 29 04 AD 83 23 9D 29 45
09B9:D8 CA D0 F2 A0 01 D0 02 E0
09C1:A0 00 B9 28 04 09 80 99 BC
09C9:28 04 20 E6 08 8D CD 26 9B
09D1:B9 28 04 29 7F 99 28 04 94
09D9:AD CD 26 AE 93 0A DD 93 F9
09E1:0A F0 3A CA D0 F8 C9 20 47
09E9:90 D8 C9 80 90 04 C9 A0 B4
09F1:90 D0 20 A9 0A 8D CD 26 67
09F9:8C CE 26 CE 26 A2 77 83
0A01:BD 28 04 C9 1F F0 BB CA 1A
0A09:BD 28 04 9D 29 04 CA EC 3C
0A11:CE 26 D0 F4 AD CD 26 99 0A
0A19:28 04 C8 D0 A5 CA 8A 0A DF
0A21:AA BD 9C 0A 48 BD 9B 0A A8
0A29:48 60 A0 00 B9 28 04 C9 CD
0A31:1F F0 06 99 3C 03 C8 D0 BB
0A39:F3 A9 00 99 3C 03 8C BE 11
0A41:26 60 AD 85 23 F0 20 C0 6C
0A49:00 F0 01 88 4C C3 09 AD 73
0A51:85 23 F0 13 B9 28 04 C9 80
0A59:1F F0 F1 C8 4C C3 09 AD 35
0A61:85 23 F0 03 4C C3 09 AD 80
0A69:CD 26 A6 C6 E0 0A B0 BA 7A
0A71:9D 77 02 E6 C6 4C 2B 0A A8
0A79:C0 00 F0 D0 88 9B AA BD D2
0A81:29 04 9D 28 04 E8 C9 1F D7
0A89:D0 F5 A9 20 9D 28 04 4C 9C
0A91:C3 09 07 0D 14 5F 91 11 CD
0A99:9D 1D 2A 0A 78 0A C2 09 24
0AA1:5F 0A 5F 0A 42 0A 4F 0A 57
0AA9:C9 63 B0 03 29 3F 60 29 F1
0AB1:7F 60 C9 40 B0 07 C9 20 30
0AB9:B0 02 09 40 60 09 80 60 54
0AC1:A9 3A AC 81 23 CD 12 D0 2C
0AC9:D0 05 A9 01 AC 82 23 8C 0F
0AD1:21 D0 BD 12 D0 C9 01 F0 1E
0AD9:08 A9 01 8D 19 D0 4C BC B6
0AE1:FE 8D 19 D0 4C 31 EA 78 7E
0AE9:A9 00 8D 0E DC A9 1B 8D B6
0AF1:11 D0 A9 C1 8D 14 03 A9 80
0AF9:0A 8D 15 03 A9 01 8D 1A CF
```

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```
0B01:D0 8D 12 D0 58 60 78 A9 11
0B09:00 8D 1A D0 A9 31 8D 14 14
0B11:03 A9 EA 8D 15 03 A9 01 52
0B19:8D 0E DC 58 60 A9 00 C5 2D
0B21:7D A2 02 20 49 09 20 E6 76
0B29:08 29 7F C9 59 D0 03 20 4E
0B31:36 0B 4C 86 09 20 57 0B 99
0B39:A9 09 20 65 09 A9 2C 8D 95
0B41:D1 23 20 8F 0B 20 E5 0D B7
0B49:A5 2F 85 33 A5 30 85 34 0F
0B51:A9 00 8D D0 23 60 AD 81 72
0B59:26 85 F8 AD 82 26 85 FC F2
0B61:A0 00 98 91 FB C8 D0 FB 94
0B69:E6 FC A6 FC EC 84 26 D0 6D
0B71:F2 A9 01 8D 86 26 8D 87 D3
0B79:26 85 45 85 46 60 AD 82 96
0B81:23 8D 21 D0 AD 84 23 8D 11
0B89:20 D0 20 07 09 60 20 95 F7
0B91:0B 4C 13 0C A9 C8 85 D1 B0
0B99:A9 04 85 D2 A0 00 AE 87 4D
0BA1:26 A9 00 8D 88 26 8D 8C 5C
0BA9:26 F8 AD BB 26 18 69 01 E7
0BB1:8D BB 26 AD BC 26 69 00 6E
0BB9:8D 8C 26 CA D0 EC D8 A2 C5
0BC1:00 20 F0 0B F8 AD BB 26 CA
0BC9:18 69 01 8D 8B 26 AD BC CD
0BD1:26 69 00 8D 8C 26 D8 A5 04
0BD9:D1 18 69 28 85 D1 A5 D2 20
0BE1:69 00 85 D2 A0 00 E8 E0 42
0BE9:14 D0 D6 20 F0 0B 60 AD 3D
0BF1:BC 26 18 69 B0 91 D1 C8 C1
0BF9:AD BB 26 29 F0 4A 4A 4A 8C
0C01:4A 18 69 B0 91 D1 C8 AD 8F
0C09:BB 26 29 0F 18 69 B0 91 F7
0C11:D1 60 A9 04 85 D2 A9 A0 0B
0C19:85 D1 A0 00 A9 A0 91 D1 41
0C21:C8 91 D1 C8 91 D1 C8 AE DC
0C29:86 26 A9 00 8D 85 26 8D CF
0C31:88 26 8E BB 26 4A 69 00 D1
0C39:AA CA A9 A0 91 D1 C8 CA C8
0C41:D0 FA AD BB 26 0A AA BD 5E
0C49:D2 23 09 80 91 D1 C8 BD DF
0C51:D3 23 09 80 91 D1 C8 AE 59
0C59:BB 26 BD 88 26 4A AA CA 93
0C61:CA A9 A0 91 D1 C8 CA 10 CD
0C69:FA AE BB 26 BD 88 26 18 F8
0C71:6D 85 26 8D 85 26 E8 BD 93
0C79:88 26 18 6D 85 26 C9 25 B6
0C81:90 AD CA 8E C4 26 A9 A0 42
0C89:C0 2B D0 01 60 91 D1 C8 EB
0C91:C0 28 D0 F9 60 20 A2 09 9F
0C99:AD 3C 03 F0 3F C9 3D F0 93
0CA1:26 AE A4 08 DD A4 08 F0 10
0CA9:07 CA D0 F8 A9 01 D0 19 AD
0CB1:AD BE 26 C9 25 B0 25 A0 B8
0CB9:3C A9 03 20 E0 0C 20 79 AD
0CC1:00 D0 E9 A9 00 F0 02 A9 57
0CC9:02 8D BD 26 AD D1 23 8D E8
0CD1:BF 26 18 20 B8 20 20 18 F6
0CD9:21 20 F4 1C 4C 4D 08 85 18
0CE1:7B 84 7A 20 79 00 4C F3 82
0CE9:BC A2 32 A9 00 8D CA 26 DB
0CF1:BD 88 26 18 6D CA 26 8D C1
0CF9:CA 26 C9 25 B0 03 CA D0 84
0D01:EF E8 E8 8E CE 26 60 AD D0
0D09:8D 02 C9 05 F0 04 A2 06 D6
0D11:D0 02 A2 0E A0 00 A9 25 C6
0D19:20 49 09 20 E6 08 29 7F E1
0D21:C9 4C F0 0F C9 43 F0 0F 8E
0D29:C9 52 F0 03 4C E2 0D A2 B5
0D31:0C D0 06 A2 0B D0 02 A2 9A
0D39:04 AD D1 23 29 F0 8D CD 23
0D41:26 8A 0D CD 26 8D CD 26 B8
0D49:4C 8A 0D AD 8D 02 C9 05 B5
0D51:F0 04 A2 06 D0 02 A2 0E 7B
0D59:A0 30 A9 25 20 49 09 20 AF
0D61:CC 10 F0 7D A0 00 A9 02 36
0D69:20 E0 0C 20 AA B1 C9 00 FE
0D71:D0 6F C0 10 B0 6B AD D1 49
0D79:23 29 0C 8D CD 26 98 0A 0C
0D81:0A 0A 0A 0D CD 26 8D CD 25
0D89:26 AD 81 23 C9 06 F0 41 0E
0D91:AD CD 26 8D D1 23 AD 81 8B
0D99:26 85 39 AD 82 26 85 3A 1C
0DA1:A0 01 B1 39 F0 11 85 2E 1B
0DA9:88 B1 39 85 2D B1 2D 29 A7
0DB1:03 0D D1 23 91 2D C8 A5 75
0DB9:39 18 69 02 85 39 A5 3A 5A
0DC1:69 00 85 3A A5 3A C5 30 B6
0DC9:D0 D8 38 20 B8 20 4C E2 4D
0DD1:0D 38 20 BB 20 90 0A A0 08
0DD9:00 AD CD 26 0D BD 26 91 B8
0DE1:2D 4C 86 09 A5 45 8D C2 27
0DE9:26 A5 46 8D C3 26 A9 03 2F
0DF1:8D 85 26 AE 86 26 86 45 03
0DF9:AC 87 26 84 46 98 18 69 87
0E01:14 8D C0 26 BD 88 26 8D EE
0E09:CA 26 A9 00 EC C2 26 D0 D8
0E11:07 CC C3 26 D0 02 A9 80 21
0E19:8D C5 26 98 18 69 05 38 64
0E21:ED 87 26 A8 B9 86 23 85 19
0E29:D2 B9 9F 23 85 D1 38 20 47
0E31:B8 20 B0 05 A9 20 4C C0 3F
0E39:0E AD BD 26 F0 6E C9 02 B8
0E41:F0 6A AD CA 26 38 ED BE 7F
0E49:26 AA E8 30 32 E8 AD BF 93
0E51:26 29 0C C9 08 F0 28 B0 ED
0E59:05 8A 4A F0 22 AA 8E C6 92
0E61:26 A9 20 0D C5 26 AC 85 75
0E69:26 91 D1 C8 CA D0 FA 8C DF
0E71:C7 26 AD CA 26 38 ED C6 12
0E79:26 AA A0 02 4C 8B 0E AE E2
0E81:CA 26 AD 85 26 8D C7 26 B7
0E89:A0 02 B1 2D 8C C6 26 AC F7
0E91:C7 26 0D C5 26 91 D1 AC E0
0E99:C6 26 EE C7 26 CA F0 09 44
0EA1:C8 CC BE 26 D0 E4 20 02 EB
0EA9:0F 4C CF 0E 20 4A 0F AE 9B
0EB1:BE 26 CA CA CA EC CA 26 82
0EB9:B0 03 4C 43 0E A9 2A 0D 25
0EC1:C5 26 AC B5 26 AE CA 26 DF
0EC9:91 D1 C8 CA D0 FA A4 46 EA
0ED1:A6 45 C8 CC C0 26 F0 05 FD
0ED9:84 46 4C 05 0E AC 87 26 FB
0EE1:84 46 AD CA 26 18 6D 85 26
0EE9:26 8D 85 26 E8 86 45 E0 5C
0EF1:33 F0 27 BD 88 26 18 6D 1F
0EF9:85 26 C9 28 B0 1C 4C 05 B1
0F01:0E E0 00 F0 14 AD 85 26 F5
0F09:18 6D CA 26 A8 B8 A9 20 25
0F11:0D C5 26 91 D1 88 CA D0 1C
0F19:FA 60 A9 28 38 ED 85 26 2F
0F21:8D CA 26 A0 05 84 46 B9 08
0F29:86 23 85 D2 B9 9F 23 85 49
0F31:D1 AC 85 26 AE CA 26 A9 0D
0F39:20 91 D1 C8 CA D0 FA E6 09
```

```
ØF41:46 A4 46 CØ 19 DØ E0 AD FB
ØF49:C2 26 85 45 AD C3 26 85 A5
ØF51:46 AØ ØØ A9 2Ø 99 28 Ø4 11
ØF59:C8 CØ 78 DØ F8 38 2Ø B8 C9
ØF61:2Ø 9Ø 35 AØ Ø2 A2 ØØ AD AC
ØF69:BD 26 C9 Ø2 DØ Ø9 AC BE ØC
ØF71:26 B1 2D 8D BE 26 C8 B1 5F
ØF79:2D 9D 28 Ø4 E8 C8 CC BE 9D
ØF81:26 DØ F4 A9 1F 9D 28 Ø4 E3
ØF89:AE 8D 26 BD CD 23 8D 27 4C
ØF91:Ø4 AD 86 Ø2 8D 27 D8 6Ø 29
ØF99:A9 2Ø 8D 27 Ø4 A9 1F 8D 48
ØFA1:28 Ø4 6Ø A9 2Ø 8D ØØ Ø2 B4
ØFA9:AØ Ø2 B1 2D C9 2A FØ F2 6D
ØFB1:AD BF 26 4A 4A 4A 4A 8D 9D
ØFB9:C8 26 A2 FF C9 ØF FØ E2 69
ØFC1:B1 2D C9 2E DØ Ø9 AE C8 FØ
ØFC9:26 FØ 1Ø E8 8E ØØ Ø2 99 D9
ØFD1:FF Ø1 C8 CC BE 26 FØ Ø3 89
ØFD9:CA DØ E5 AD C8 26 FØ 1E Ø8
ØFE1:E0 ØØ FØ 1A AD ØØ Ø2 C9 6B
ØFE9:2Ø DØ ØA A9 2E 99 FF Ø1 Ø1
ØFF1:C8 AE C8 26 E8 A9 3Ø 99 83
ØFF9:FF Ø1 C8 CA DØ F9 A9 2Ø FF
1ØØ1:8D ØØ Ø2 CC BE 26 FØ ØC 71
1ØØ9:BØ 3F B1 2D C9 2E FØ Ø8 4B
1Ø11:C9 35 BØ ØC C8 4C 4A 1Ø 56
1Ø19:C8 B1 2D C9 35 9Ø 2A 88 15
1Ø21:98 C8 AA CA CA BD ØØ Ø2 11
1Ø29:C9 2E FØ ØB 9Ø ØC C9 39 ØA
1Ø31:DØ 14 A9 3Ø 9D ØØ Ø2 CA B2
1Ø39:1Ø EB CA 9D ØØ Ø2 E8 A9 13
1Ø41:31 9D ØØ Ø2 DØ Ø3 FE ØØ 12
1Ø49:Ø2 88 8C BE 26 AD ØØ Ø2 F3
1Ø51:C9 2Ø DØ Ø9 A9 Ø1 85 2E 93
1Ø59:A9 FF 85 2D 6Ø A9 Ø1 85 Ø3
1Ø61:2E A9 FE 85 2D EE BE 26 Ø4
1Ø69:6Ø AD 8D Ø2 C9 Ø5 FØ Ø5 4Ø
1Ø71:A2 Ø5 4C 78 1Ø A2 ØD A9 Ø4
1Ø79:24 AØ A1 2Ø 49 Ø9 2Ø CC 85
1Ø81:1Ø AØ ØØ A9 Ø2 2Ø EØ ØC CA
1Ø89:2Ø AA B1 C9 ØØ DØ 35 CØ A5
1Ø91:Ø4 9Ø 31 CØ 25 BØ 2D A5 F5
1Ø99:45 8D 86 26 AD 81 23 C9 76
1ØA1:Ø5 FØ Ø7 98 2Ø 65 Ø9 4C DF
1ØA9:B1 1Ø 98 A6 45 9D 88 26 FB
1ØB1:2Ø EA ØC A5 45 CD CE 26 9D
1ØB9:9Ø Ø7 AC CE 26 88 8C 86 59
1ØC1:26 2Ø 13 ØC 4C 86 Ø9 A9 58
1ØC9:Ø1 DØ Ø2 A9 ØØ 8D C9 26 69
1ØD1:AØ ØØ 84 D4 A9 A4 2Ø D2 13
1ØD9:FF A9 9D 2Ø D2 FF 2Ø E6 D7
1ØE1:Ø8 C9 ØD FØ 3D C9 14 FØ 53
1ØE9:24 AA 29 7F C9 2Ø 9Ø EE C2
1ØF1:8A AE C9 26 DØ Ø8 C9 3Ø Ø9
1ØF9:9Ø E4 C9 3A BØ E8 A6 D3 A2
1101:E0 26 FØ DA 99 ØØ Ø2 2Ø D9
1109:D2 FF C8 DØ C7 CØ ØØ FØ EC
1111:CD A9 2Ø 2Ø D2 FF A9 9D 12
1119:2Ø D2 FF 2Ø D2 FF 88 4C F5
1121:D5 1Ø A9 2Ø 2Ø D2 FF A9 5F
1129:Ø0 99 ØØ Ø2 8C C8 26 AD 53
1131:ØØ Ø2 6Ø A5 46 C9 C8 FØ 16
1139:12 E6 46 AD 87 26 18 69 3Ø
1141:13 C5 46 BØ Ø6 EE 87 26 53
1149:2Ø 95 ØB 6Ø A5 46 C9 Ø1 23
1151:FØ 1Ø C6 46 AC 87 26 88 85
1159:C4 46 9Ø Ø6 CE 87 26 2Ø E2
1161:95 ØB 6Ø A5 45 C9 32 FØ 1E
1169:23 E6 45 AC C4 26 C4 45 D7
1171:BØ 1A EE 86 26 AE 86 26 D7
1179:A9 ØØ 18 7D 88 26 E8 C9 C3
1181:25 9Ø F7 CA CA E4 45 9Ø ØB
1189:E9 2Ø 13 ØC 6Ø A5 45 C9 B9
1191:Ø1 FØ 1Ø C6 45 AC 86 26 EE
1199:88 C4 45 9Ø Ø6 CE 86 26 81
11A1:2Ø 13 ØC 6Ø A9 24 AØ A9 E8
11A9:A2 Ø6 2Ø 49 Ø9 2Ø C8 1Ø A1
11B1:A9 Ø1 85 7B A9 FF 85 7A 24
11B9:2Ø 73 ØØ 9Ø 4E 38 E9 41 3A
11C1:3Ø 49 FØ Ø6 C9 Ø2 BØ 43 C7
11C9:A9 1A 8D CD 26 2Ø 73 ØØ 6E
11D1:9Ø 39 38 E9 4Ø 3Ø 34 FØ 4C
11D9:32 C9 1B BØ 2E 18 6D CD 7Ø
11E1:26 C9 33 BØ 26 8D CD 26 24
11E9:2Ø 73 ØØ BØ 1E 2Ø F3 BC 1A
11F1:2Ø AA B1 C9 ØØ DØ 14 CØ CD
11F9:ØØ FØ 1Ø CØ C9 BØ ØC CØ 5Ø
1201:B6 9Ø ØB A9 B5 8D 87 26 B9
1209:4C 12 12 4C 86 Ø9 8C 87 D7
1211:26 84 46 2Ø EA ØC AD CD E4
1219:26 CD CE 26 9Ø ØA AC CE D4
1221:26 88 8C 86 26 4C 2C 12 41
1229:8D 86 26 85 45 2Ø 8F ØB A7
1231:4C 86 Ø9 AD 86 26 C5 45 B6
1239:DØ 17 AD 87 26 C5 46 DØ 5F
1241:1Ø A9 Ø1 8D 86 26 85 45 ED
1249:8D 87 26 85 46 2Ø 8F ØB 1Ø
1251:6Ø AD 86 26 85 45 AD 87 68
1259:26 85 46 6Ø 2Ø 73 ØØ 8D 1D
1261:E1 26 2Ø 73 ØØ 8D E2 26 5D
1269:2Ø 73 ØØ 8D E3 26 2Ø 73 BE
1271:ØØ C9 28 FØ Ø3 4C 62 23 4D
1279:AE C2 12 AD E1 26 DD C2 E8
1281:12 FØ Ø6 CA DØ F5 4C 62 B1
1289:23 AD E2 26 DD CE 12 FØ A8
1291:Ø2 DØ FØ AD E3 26 DD DA 32
1299:12 DØ E8 8E BB 26 EØ ØB 44
12A1:BØ ØC 8A 48 A9 ØØ 48 4C 21
12A9:1A 22 68 8D BB 26 2Ø 73 73
12B1:ØØ AE BB 26 CA 8A ØA AA 9A
12B9:BD E8 12 48 BD E7 12 48 B7
12C1:6Ø ØC 41 41 43 45 49 4C 63
12C9:53 53 53 54 53 41 42 54 94
12D1:4F 58 4E 4F 47 49 51 41 B5
12D9:55 56 53 4E 53 5Ø 54 47 59
12E1:4E 4E 52 4E 4D 45 57 8C DA
12E9:ØD E3 63 E2 EC BF CB BC E2
12F1:E9 B9 38 BC 6A E2 7Ø BF CB
12F9:B3 E2 Ø1 14 69 14 2Ø BC AA
1301:13 8E E4 26 8C E6 26 2Ø BF
1309:79 ØØ C9 3A DØ 3F 2Ø 73 FF
1311:ØØ 2Ø BC 13 8E E5 26 8C EC
1319:E7 26 2Ø 79 ØØ C9 29 DØ A2
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1339:Ø3 4C 62 23 E8 C8 A5 45 6D
1341:8D CB 26 A5 46 8D CC 26 68
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1361:C8 B1 2D 8D CE 26 A2 ØØ 2B
1369:C8 B1 2D 9D ØØ Ø2 E8 C8 82
1371:CC CE 26 DØ F4 A5 7A 48 FE
1379:A5 7B 48 A9 ØØ 9D ØØ Ø2 6D
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1389:85 7B 68 85 7A A5 45 CD 79
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13A1:E7 26 FØ Ø4 E6 46 18 6Ø 84
13A9:38 6Ø AD CB 26 85 45 AD F5
13B1:CC 26 85 46 18 2Ø B8 2Ø AF
13B9:4C 62 23 A2 ØØ 2Ø 79 ØØ A0
13C1:C9 41 FØ Ø6 C9 42 DØ E2 77
13C9:A2 1A 8E CD 26 2Ø 73 ØØ 9F
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13D9:38 E9 4Ø 18 6D CD 26 C9 D8
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13F9:B1 CØ C9 BØ AD AE CD 26 57
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1409:8D BC 26 2Ø FF 12 2Ø 51 C7
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1419:48 A5 65 48 A5 64 48 A5 F4
1421:63 48 45 62 48 A5 61 48 CB
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1431:2Ø 51 13 Ø8 68 8D CD 26 DB
1439:68 85 69 68 85 6A 68 85 D6
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1449:85 6E 45 66 85 6F A5 61 75
1451:2Ø 6A B8 AD CD 26 48 28 D5
1459:9Ø B9 AD CB 26 85 45 AD 2A
1461:CC 26 85 46 18 2Ø B8 2Ø 61
1469:6Ø 2Ø Ø2 14 A2 Ø6 B5 6Ø 44
1471:95 68 CA DØ F9 AD 8C 26 ØB
1479:AC BB 26 2Ø 91 B3 A5 6E C2
1481:45 66 85 6F A5 61 2Ø E6 67
1489:22 6Ø A9 Ø0 8D 2Ø DØ 8D 2C
1491:21 DØ 2Ø BD FF A9 ØB 8D A8
1499:86 Ø2 2Ø 07 ØB A9 93 2Ø 40
14A1:D2 FF A9 Ø4 8D E8 26 A9 AE
14A9:07 8D E9 26 AD 8D Ø2 C9 C9
14B1:Ø5 FØ Ø3 4C 3B 15 A9 26 65
14B9:AØ 23 A2 Ø0 2Ø 49 Ø9 2Ø A7
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14C9:FØ 11 C9 5Ø FØ 2E 4C 49 0F
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14D9:26 DØ 5F A9 Ø8 8D E8 26 3E
14E1:A9 Ø1 8D E9 26 AØ 4E A9 69
14E9:26 2Ø 49 Ø9 2Ø C8 1Ø AD D8
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1519:16 8D E8 26 A9 26 AØ Ø0 E6
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1569:8D C3 26 A9 Ø1 85 45 85 D8
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1589:3C Ø3 CA 1Ø FA 38 2Ø B8 9E
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1599:DØ 23 AD CA 26 38 ED BE Ø4
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15A9:26 29 Ø0 C9 Ø8 FØ Ø0 AB 18
15B1:27 8A 4A FØ 04 AA 4C D9 A7
15B9:15 A2 Ø0 FØ 1B 2Ø A4 Ø0 D7
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15C9:26 9Ø CF AE CA 26 A9 2A 7C
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15D9:AØ Ø2 B1 2D 2Ø B3 Ø0 A9 5F
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15E9:05 CC BE 26 DØ EC A2 Ø0 83
15F1:AD 8D Ø2 29 Ø1 DØ F9 A5 Ø0
15F9:91 1Ø 2C BD 3C Ø3 FØ Ø6 28
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1619:0E E6 46 A9 Ø1 85 45 A9 B8
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1629:0D 2Ø D2 FF A9 04 2Ø C3 9F
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1639:45 AD C3 26 85 46 AD E8 D7
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1649:2Ø 7F ØB 2Ø E8 ØA 2Ø 8F Ø8
1651:0B 4C 86 Ø9 AD 8D Ø2 8D AC
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1661:8D D2 26 A5 45 8D D3 26 56
1669:A5 46 8D D4 26 4C 8D 16 8C
1671:4C 86 Ø9 AD 8D Ø2 8D D1 C2
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1681:D2 26 A5 45 8D D3 26 A5 57
1689:46 8D D4 26 2Ø CA 16 AD 3F
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1699:8D D8 26 2Ø D6 16 AE D3 C9
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16E9:13 17 F0 06 CA D0 F8 4C BB
16F1:DF 16 CA 8A 0A AA A9 16 F9
16F9:48 A9 DE 48 BD 1B 17 48 E5
1701:BD 1A 17 48 60 68 68 A5 17
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1731:C9 B0 54 AD D9 26 85 45 8D
1739:AD DA 26 85 46 38 20 B8 1E
1741:20 90 45 A0 02 AD BD 26 BE
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1791:85 46 18 20 B8 20 90 EF 70
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17B9:01 60 AD DB 26 38 ED D9 BB
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17C9:ED DA 26 8D E0 26 A2 00 28
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17D9:0A 9D 28 04 E8 EC BE 26 58
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17E9:28 85 7A A9 04 85 7B A9 4E
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17F9:79 00 20 DA 18 20 73 00 BE
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1831:26 C9 33 B0 57 18 6D DF 2E
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1851:26 20 DA 18 20 73 00 B0 F8
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18B1:20 DA 18 20 73 00 4C FB DD
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18F1:26 8D DD 26 AD D8 26 38 0C
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1A31:26 CE DC 26 AD D7 26 8D D0
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1EA9:8C C8 26 60 CE BB 26 A2 7D
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1EB9:2E F0 F8 C9 45 F0 06 99 98
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20A9:8D 26 AD CF 26 8D BF 26 12
20B1:AD CE 26 8D BE 26 60 08 71
20B9:A6 45 CA 86 39 A9 C8 85 E7
20C1:3A 18 A9 00 A2 08 6A 66 CA
20C9:39 90 03 18 65 3A CA 10 66
20D1:F5 85 3A A6 46 CA 8A 18 AA
20D9:65 39 85 39 A5 3A 69 00 48
20E1:85 3A 06 39 26 3A A5 3A 67
20E9:6D 82 26 85 3A A0 01 B1 A6
20F1:39 D0 03 28 18 60 AA 88 06
20F9:B1 39 85 2D 86 2E 28 90 B2
2101:14 B1 2D 29 03 8D BD 26 E1
2109:B1 2D 29 FC 8D BF 26 C8 E4
2111:B1 2D 8D BE 26 38 60 20 08
2119:20 1F AD BD 26 C9 02 F0 12
2121:32 EE BE 26 EE BE 26 A0 D1
2129:00 A5 33 91 39 C8 A5 34 C0
2131:91 39 88 AD BD 26 0D BF D6
2139:26 91 33 C8 AD BE 26 91 2C
2141:33 C8 A2 00 BD 3C 03 91 1A
2149:33 C8 E8 CC BE 26 D0 F4 66
2151:4C A7 21 20 E7 21 EE C8 34
2159:26 EE C8 26 38 AD C8 26 16
2161:6D BE 26 8D BE 26 AC C8 58
2169:26 AD BE 26 91 33 A2 00 03
2171:C8 BD 3C 03 91 33 C8 E8 13
2179:CC BE 26 D0 F4 A0 00 A5 73
2181:33 91 39 C8 A5 34 91 39 CF
2189:88 AD BD 26 0D BF 26 91 DA
2191:33 C8 AD C8 26 91 33 C8 88
2199:A2 02 BD FE 01 91 33 C8 D2
21A1:E8 EC C8 26 D0 F4 A5 33 E7
21A9:18 6D BE 26 90 06 A5 34 A9
21B1:C9 9F F0 0F A5 33 18 6D 67
21B9:BE 26 85 33 A5 34 69 00 99
21C1:85 34 60 A9 00 85 C6 A8 C6
21C9:91 39 C8 91 39 A9 25 A0 B0
21D1:89 A2 00 20 49 09 A5 45 82
21D9:8D 86 26 A5 46 8D 87 26 41
21E1:A2 FD 9A 4C 4D 08 BA 8E 9B
21E9:D0 26 A2 00 A0 00 BD 3C 2F
21F1:03 20 B3 0A C9 20 D0 01 66
21F9:C8 C9 29 D0 01 88 9D 3C E6
2201:03 E8 EC BE 26 D0 E7 C0 8F
2209:00 F0 03 4C 62 23 A9 00 A1
2211:48 A9 3C 85 7A A9 03 85 C9
2219:7B 20 73 00 90 4C C9 2D 08
2221:F0 48 C9 2B F0 44 C9 2E 36
2229:F0 40 C9 50 F0 25 C9 28 0C
2231:F0 15 C9 41 F0 0B C9 42 0A
2239:F0 07 C9 40 F0 0F 4C 62 B3
2241:23 20 FE 1F 4C 6E 22 A9 FA
2249:01 48 4C 1A 22 20 5D 12 A9
2251:4C 6E 22 20 73 00 C9 49 16
2259:F0 03 4C 62 23 A9 A8 A0 38
2261:AE 20 A2 BB 20 73 00 4C 30
2269:6E 22 20 F3 BC 20 79 00 0A
2271:F0 78 A2 02 C9 2B F0 35 D2
2279:E8 C9 2D F0 30 E8 C9 2A 3C
2281:F0 2B E8 C9 2F F0 26 E8 35
2289:C9 5E F0 21 C9 29 F0 03 52
2291:4C 62 23 68 F0 14 C9 01 EB
2299:F0 07 48 20 2E 23 4C 94 4E
22A1:22 E6 7A D0 02 E6 7B 4C FB
22A9:6E 22 4C AB 12 86 4B 68 9B
2281:48 A8 B9 B8 23 DD B8 23 2C
22B9:90 10 20 2E 23 A6 4B 68 E3
22C1:48 A8 B9 B8 23 DD B8 23 3C
22C9:B0 F0 20 1B BC A5 66 48 E9
22D1:A5 65 48 A5 64 48 A5 63 98
22D9:48 A5 62 48 A5 61 48 A5 65
22E1:4B 48 4C 1A 22 F0 7A 4C 1F
22E9:12 BB 68 48 F0 06 20 2E C5
22F1:23 4C EB 22 68 20 DD BD B7
22F9:A0 00 AD 00 01 C9 20 F0 A4
2301:21 B9 00 01 99 00 02 F0 18
2309:03 C8 D0 F5 8C C8 26 A2 F2
2311:00 BD 3C 03 F0 09 20 A9 14
2319:0A 9D 3C 03 E8 D0 F2 4C 40
2321:26 1E B9 01 01 99 00 02 B9
2329:F0 E2 C8 D0 F5 68 85 FB 1F
2331:68 85 FC 68 85 4C 68 85 E6
2339:69 68 85 6A 68 85 6B 68 3E
2341:85 6C 68 85 6D 68 85 6E 51
2349:45 66 85 6F A5 4C 0A A8 8E
2351:A5 FC 48 A5 FB 48 B9 C0 42
2359:23 48 B9 BF 23 48 A5 61 5D
2361:60 AE D0 26 9A A9 07 8D 17
2369:C8 26 A0 00 B9 9A 24 99 CB
2371:00 02 C8 C0 07 D0 F5 A9 6E
2379:00 99 00 02 4C 10 23 00 2F
2381:00 0B 0C 00 00 04 04 04 28
2389:04 04 04 05 05 05 05 DE
2391:05 05 06 06 06 06 06 17
2399:06 07 07 07 07 07 00 28 72
23A1:50 78 A0 C8 F0 18 40 68 9F
23A9:90 B8 E0 08 30 58 80 A8 8F
23B1:D0 F8 20 48 70 98 C0 00 8E
23B9:01 02 02 03 03 04 F4 22 A5
23C1:F4 22 69 B8 52 B8 2A BA 48
23C9:E5 22 7A BF 4E 54 46 00 27
23D1:2C 20 20 41 41 41 42 41 23
23D9:43 41 44 41 41 45 41 46 41 AB
23E1:47 41 48 41 49 41 4A 41 5E
23E9:4B 41 4C 41 4D 41 4E 41 11
23F1:4F 41 50 41 51 41 52 41 C3
23F9:53 41 54 41 55 41 56 41 76
2401:57 41 58 41 59 41 5A 42 2B
2409:41 42 42 42 43 42 44 42 DC
2411:45 42 46 42 47 42 48 42 8F
2419:49 42 4A 42 4B 42 4C 42 42
2421:4D 42 4E 42 4F 42 50 42 F4
2429:51 42 52 42 53 42 54 42 A7
2431:55 42 56 42 57 42 58 9B B3
2439:C5 D8 C9 D4 3A 20 20 C1 75
2441:52 45 20 59 4F 55 20 53 01
2449:55 52 45 20 28 D9 2F CE 51
2451:29 3F 00 98 D3 50 45 45 37
2459:44 C3 41 4C 43 00 93 0E F0
2461:08 98 D3 50 45 45 44 C3 DE
2469:41 4C 43 20 42 59 20 CB 53
2471:45 56 49 4E 20 CD 41 52 0D
2479:54 49 4E 00 9B C3 CC C5 53
2481:C1 D2 3A 20 20 C1 52 45 9A
2489:20 59 4F 55 20 53 55 52 C2
2491:45 20 28 D9 2F CE 29 3F 6D
2499:00 2A 45 12 12 0F 12 2A 51
24A1:90 D7 49 44 54 48 3A 00 CD
24A9:9B C7 4F 54 4F 3A 00 9B DF
24B1:C3 48 41 4E 47 45 20 54 DE
24B9:4F 3A 20 20 12 D4 92 45 8C
24C1:58 54 2C 20 12 CE 92 55 19
24C9:4D 45 52 49 43 2C 20 4F 43
24D1:52 20 12 C6 92 4F 52 4D BD
24D9:55 4C 41 3F 00 90 D2 45 29
24E1:43 41 4C 43 55 4C 41 54 8C
24E9:49 4F 4E 20 49 53 20 4F 9D
24F1:00 98 D3 41 56 45 3A 00 2B
24F9:98 CC 4F 41 44 3A 00 9B 66
2501:C6 CF D2 CD C1 D4 3A 20 CF
2509:20 12 CC 92 45 46 54 2C C2
2511:20 12 C3 92 45 4E 54 45 E2
2519:52 2C 20 4F 52 20 12 D2 9A
2521:92 49 47 48 54 20 4A 55 81
2529:53 54 49 46 59 3F 00 9B 23
2531:C6 CF D2 CD C1 D4 3A 20 FF
2539:20 23 20 4F 46 20 44 45 D5
2541:43 49 4D 41 4C 20 50 4C 0D
2549:41 43 45 53 3A 00 9B C4 B0
2551:49 53 4B 20 43 4F 4D 4D BF
2559:41 4E 44 3A 00 24 0D D0 7F
2561:52 45 53 53 20 12 D2 C5 7A
2569:D4 D5 D2 CE 92 00 9B D0 77
2571:52 4F 43 45 53 53 49 4E 3E
2579:47 20 44 41 54 41 20 54 48
2581:52 41 4E 53 46 45 52 00 30
2589:9E CE 4F 54 20 45 4E 4F 08
2591:55 47 48 20 52 4F 4F 4D 1F
2599:20 54 4F 20 45 4E 54 45 46
25A1:52 20 44 41 54 41 00 9B FC
25A9:CD 4F 56 45 20 43 55 52 D8
25B1:53 4F 52 20 54 4F 20 54 3A
25B9:4F 50 20 4C 45 46 54 20 94
25C1:4F 46 20 4E 45 57 20 50 46
25C9:4F 53 49 54 49 4F 4E 00 23
25D1:98 CD 4F 56 45 20 43 55 33
25D9:52 53 4F 52 20 54 4F 20 42
25E1:42 4F 54 54 4F 4D 20 52 33
25E9:49 47 48 54 20 4F 46 20 E3
25F1:42 4C 4F 43 4B 00 97 D0 E8
25F9:52 49 4E 54 49 4E 47 2E 0F
2601:2E 2E 00 97 C4 45 56 49 9A
2609:43 45 20 23 00 97 D3 45 C9
2611:43 4F 4E 44 41 52 59 20 07
2619:C1 44 44 52 45 53 53 20 43
2621:23 00 97 D0 D2 C9 CE D4 2F
2629:20 54 4F 3A 20 12 D3 92 AB
2631:43 52 45 45 4E 2C 20 12 26
2639:C4 92 49 53 4B 2C 20 4F 85
2641:52 20 12 D0 92 52 49 4E CC
2649:54 45 52 3F 00 97 C6 49 84
2651:4C 45 4E 41 4D 45 3A 00 E6
2659:81 D2 45 43 41 4C 43 55 0F
2661:4C 41 54 49 4E 47 2E 2E 5D
2669:2E 00 9E CE 4F 54 20 41 DA
2671:20 D3 50 45 45 44 C3 41 25
2679:4C 43 20 46 49 4C 45 00 2B
```

Program 2: *SpeedScript* Integrator

Please refer to the new "MLX" article in this issue before entering the following listing.

```
0801:0B 08 00 00 9E 32 30 36 EC
0809:31 00 00 00 A9 93 20 D2 60
0811:FF A0 00 B9 B9 08 F0 06 BA
0819:20 D2 FF C8 D0 F5 20 12 2B
0821:09 8A C9 00 D0 03 4C B8 75
0829:08 A2 3C A0 03 20 BD FF 8B
0831:A9 01 A2 08 A0 00 20 8A 2B
0839:FF 20 C0 FF A2 01 20 C6 89
0841:FF A9 20 85 FC A9 00 85 2C
0849:FB 20 CF FF A6 90 D0 1D 8F
0851:C9 0D D0 02 A9 1F 48 29 47
0859:80 4A 85 02 68 29 3F 05 78
0861:02 A0 00 91 FB E6 FB D0 F7
0869:E0 E6 FC D0 DC A9 1F A0 BC
0871:00 91 FB E6 FB D0 02 E6 E1
0879:FC A9 01 20 C3 FF 20 CC BF
0881:FF A0 00 B9 E8 08 F0 06 A4
0889:20 D2 FF C8 D0 F5 20 12 9B
0891:09 8A C9 00 F0 21 A2 3C 8F
0899:A0 03 20 BD FF A9 01 A2 E5
08A1:08 A0 01 20 BA FF A9 20 49
08A9:85 03 A9 00 85 02 A6 FB EF
08B1:A4 FC A9 02 20 D8 FF 60 6D
08B9:0E C6 49 4C 45 4E 41 4D A3
08C1:45 20 4F 46 20 D3 50 52 0E
08C9:45 41 44 D3 48 45 45 54 C8
08D1:20 46 49 4C 45 20 50 52 0F
08D9:49 4E 54 45 44 20 54 4F 9B
08E1:20 44 49 53 4B 3A 00 C6 7B
08E9:49 4C 45 4E 41 4D 45 20 29
08F1:4F 46 20 D3 50 45 45 44 E2
08F9:D3 43 52 49 50 54 20 46 FD
0901:49 4C 45 20 54 4F 20 43 D8
0909:52 45 41 54 45 20 20 3A 28
0911:00 A2 00 86 02 20 E4 FF 8E
0919:F0 FB A6 02 C9 0D F0 1F 1B
0921:C9 14 F0 0F 20 D2 FF E0 59
0929:14 F0 EA 9D 3C 03 E6 02 76
0931:4C 16 09 E0 00 F0 DE 20 BF
0939:D2 FF C6 02 4C 16 09 20 9A
0941:D2 FF 60 00 00 00 00 00 C8
```

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Casio CZ-101 Music Synthesizer, *The Music Shop For MIDI*, And *MIDI 4/Plus* For Commodore 64

Philip I. Nelson, Assistant Editor

Requirements: Commodore 64 with a disk drive, plus an external amplification system (or headphones).

The Casio CZ-101 is a sophisticated MIDI-standard digital synthesizer. MIDI (Musical Instrument Digital Interface) is an international set of standards for electronic music devices: MIDI-standard instruments can communicate and work together, even if they're made by different manufacturers. We tested the Casio synthesizer on a Commodore 64 with a Passport Designs MIDI interface. We also tried two examples of Passport software: *The Music Shop for MIDI*, a screen-oriented music program licensed from Brøderbund, and *MIDI 4/Plus*, which Passport refers to as a "digital recording studio on disk."

On its own, the Casio CZ-101 is a powerful, programmable performance instrument capable of producing an enormous variety of sounds. Though programming your own tones takes some practice, the Casio has 32 built-in tones ranging from conventional sounds like *trumpet* and *electric piano* to the unusual *fairy tale* and *fantastic sound* #2. To help you learn sound programming, Casio includes a book of "patches" or program information for over 40 additional tones, including everything from *blues harmonica* and *human voice* to *calimba*.

Sixteen of the synthesizer's tones are programmable, and it stores these custom sounds in memory even when turned off. You program the sounds with the aid of calculator-like keys and a small liquid crystal display on the face of the synthesizer. You can store additional custom tones in an optional plug-in memory cartridge. Like other synthesizers, the Casio works either in monophonic (one-voice) or polyphonic (multivoice) modes. Four of the internal tones are eight-voice polyphonic—meaning you can play up to eight notes simultaneously—while the rest are four-voice polyphonic.

Though MIDI lets you interface the synthesizer with other devices such as computers, you can have lots of fun playing the synthesizer as a stand-alone instrument. The Casio's output jacks and adapter cable (included) make it easy to plug into an external amplifier, stereo system, studio mixer board, or an ordinary set of headphones.

One accessory you'll need right away, however, is a nine-volt power supply (the one I used cost less than $5 at an electronics surplus store). Although the Casio comes with six D batteries, they last only a few hours and are really intended for backing up internal memory.

Better Than SID

The Casio comes with three manuals: An operations manual which relates chiefly to hardware functions, a sound synthesis handbook which explains Casio's Phase Distortion method of digital sound generation, and a sound data book of preprogrammed patches.

With a MIDI interface and some software, you can plug the Casio (or any MIDI synthesizer) into a home computer and operate it under computer control rather than manually. *The Music Shop for MIDI* is a MIDI version of Don Williams' excellent 64 music program. Like the original *Music Shop*, this program features on-screen editing with conventional notation, pull-down window menus, and a choice of joystick control or keyboard commands. Of course, the MIDI version of *The Music Shop* generates sound through the synthesizer rather than the 64's built-in sound chip. If you're familiar with 64 music, the difference is immediately apparent. Bass notes are round and full—heavy enough to move furniture around the room—and there's a delicious absence of crackle or background noise. Best of all, you can input notes from the synthesizer keyboard as well as a joystick or the computer keyboard.

When evaluating any MIDI software, you should be aware that the standard itself imposes certain constraints. MIDI specifies a *minimum* standard, which individual manufacturers are free to exceed, and many MIDI instruments (including the Casio) give you extra features. Since MIDI software is necessarily designed around the standard, it may not let you use your synthesizer's extra features.

For instance, *The Music Shop for MIDI* provides access to only 16 of the Casio's built-in tones; the extra tones (including custom tones) can't be used within the program. And while multipart music is available, every note plays in the same tone: You can't play a three-part harmony with three different tones. This is ordinarily done by connecting additional MIDI devices to the system, using MIDI synthesizer #1 to play voice one, MIDI synthesizer #2 for voice two, and so on.

Multitrack Digital Recording

MIDI/4 Plus is an enhanced version of Passport's popular four-channel software sequencer for MIDI devices. This is a realtime digital recorder with some quite elaborate editing functions. While *The Music Shop for MIDI* rates high in visual appeal, *MIDI/4 Plus* is functional and totally lacking in frills. When you run the program and enter Record mode, you can play on the synthesizer and digitally record one track of music. Though the screen shows nothing but a furiously ticking clock, every aspect of your performance is recorded in system memory. When the first track is complete, you can record a second while listening to the first, then repeat the process until as many as four tracks of music are complete.

Though Passport calls this a four-channel recording system, that term is a bit modest. MIDI calls for a minimum of four separate control channels, but *MIDI/4 Plus* lets you overdub (mix) any track with another. Since digital record-

ings are free from background noise, even after many generations of rerecording, there's no practical limit to the number of times you can overdub a new track onto existing material. It's like having an unlimited number of recording tracks: No matter how many times you mix a new track onto existing material, each note sounds as clear as when you first played it. In practice, of course, the total number of notes you can record is limited by the computer's memory. Passport claims a 5,000-note capacity for this system.

MIDI/4 Plus offers a wide array of other editing tools as well. You may edit, loop, or link individual tracks, autocorrect any track to fine-tune slightly off-kilter rhythms, synchronize your music with an external MIDI sequencer or drum machine (MIDI or non-MIDI), implement velocity-sensitive or aftertouch-sensitive keyboard information, and even synchronize your music with previously recorded tracks on multitrack tape decks (using MIDI synchronizing devices such as the KORG KMS-30).

Which is the best package for you? The answer depends on your tastes and abilities. *The Music Shop for MIDI* lets you write and edit music visually, using the electronic equivalent of a sheet of music paper. This makes it ideal for the casual musician or someone who's not a keyboard virtuoso. Even if you can't play like Liszt or Herbie Hancock, you can write or transcribe music at your leisure and let the system take care of the actual performance. (Don't mistake this program for a realtime recorder, however; although you can input the pitch of each note from the synthesizer keyboard, you must still go to the computer to change other aspects of the music, such as note duration.)

If your keyboard skills are adequate for realtime recording, *MIDI/4 Plus* may be a more attractive choice, particularly if you want to create very complex music or interface with other MIDI devices.

Casio CZ-101 Synthesizer
Casio Computer Co., Ltd.
15 Gardner Road
Fairfield, NJ 07006
$499

MIDI Interface for Commodore 64 $129.95
The Music Shop for MIDI *$99.95*
MIDI/4 Plus *$99.95*
Passport Designs, Inc.
625 Miramontes Street
Suite 103
Half Moon Bay, CA 94109

The Newsroom

Kathy Yakal, Assistant Features Editor

Requirements: Apple II-series computer with at least 64K RAM and a disk drive; IBM PC/PCjr with at least 64K and a disk drive; or a Commodore 64. All versions also require a printer. Joystick and Koala-Pad optional.

The debate over how microcomputers can best be integrated into schools continues. Some software developers stress that the computer is best suited to achieving abstract goals such as encouraging critical thinking, while others promote software that is more testable and quantifiable. But there are needs that computers can serve quite well in the schools, needs that don't directly relate to curriculum. Students can use word processing programs to write papers. Teachers can use databases to keep track of grades. Administrators can use spreadsheets and other business software for record keeping.

The Newsroom, from Springboard Software, is a highly specialized program, designed to help you write, design, and print a newsletter or newspaper. Though it's being used in many schools, it has many other applications besides school newspaper production. It can be used to create newsletters for small businesses, computer user groups, or other community organizations.

The Newsroom is icon-driven; you move from one section of the program to another and issue commands by selecting the appropriate icon on the screen. The opening screen is divided into six areas, each containing an icon representing a different stage in newspaper production. You move the cursor to the area you want to work in and press the appropriate key. Then you're given a menu of icons to guide you through that part of the process.

If you want to design a logo to run across the top of the paper, you may want to start in the Banner section. You can choose from a variety of typefaces for your title, then move to the Clip Art area and select from hundreds of predesigned illustrations, pictures of animals, people, maps, trees, sports, and many other drawings. The program also provides graphics tools that allow you to modify the clip art (or design your own) and add decorative touches like borders.

The Copy Desk is where you write stories for the paper, using the program's text-editing functions. If you have people in various locations writing articles, you can go to the Wire Service section and exchange files and photos via modem with anyone else using a copy of *The Newsroom*, even if the other computer is different from yours. For example, using *The Newsroom*, an Apple II computer can exchange files with a Commodore 64 or IBM computer.

When you've written all the copy and chosen artwork, select the Layout icon and design the format for each page, then roll the Press. Printer compatibility shouldn't be a problem; the program lets you choose from a list of all major printers and interfaces. *The Newsroom* accommodates pages of either letter-size paper (8½ × 11 inches) or legal-size (8½ × 14 inches). Letter-size can contain six "panels" and a banner, or eight panels without a banner per page; legal size allows eight panels and a banner, or ten panels without a banner per page.

As the program's documentation takes you step by step through all the editorial and production stages, it also provides a brief journalism tutorial. A disk containing hundreds of additional pieces of clip art is available at extra cost.

The Newsroom
Springboard Software
7807 Creekridge Circle
Minneapolis, MN 55435
$59.95

Dr. T's Sequencer For 64 And Apple

Richard Mansfield, Senior Editor

Commodore 64 or Apple II+/IIe computer with a disk drive. An IBM version is scheduled for release in January 1986. The Commodore version was reviewed.

A sequencer is much like a highly versatile, multitrack tape recorder: You play something on a keyboard and the sequencer memorizes the notes, duration, attack, and even such things as aftertouch and pitch bend (detuning notes for special effects or added expressiveness). There are several sequencers available which transform the Commodore 64 or Apple into an effective music controller, but few approach the versatility and ease of use of Dr. T's Sequencer. It's astoundingly powerful. It gives you virtually total control over the elements of musical composition and performance.

Dr. T's includes all the features of an efficient sequencer—save/load to disk; midi control; merge, append, copy, and delete sequences; play and

overdub—but also has many additional features which are either unique or rare. For example, you can enter music three ways: realtime (you play, it memorizes); step time (you play as slowly as you want, but it memorizes the true tempo); or keyboard (you type in the notes and their parameters).

Any errors can easily be changed in edit mode. Request Edit Sequence from the main menu and you see eight parameters for each note: time from start, event number, rhythm, midi channel, on/off/bend/delete, pitch, velocity, duration. As with a word processor, you have considerable control over the final sounds, and you can even listen to any portion of your music from within Edit mode.

You can work with a generous maximum of 35 sequences and 3300 notes simultaneously. In addition to copying and appending sequences, you can merge them. You can create a melody in one sequence and harmony in another. Then, after you play them back together and correct any errors, you can merge the two together quite easily. Similarly, you can overdub in realtime and even manipulate pitch and other factors while you're listening to a playback. From any position within a sequence, you can trigger another sequence. Among other things, this allows you to create "controller sequences" which have no musical content, but act as conductors of other musical sequences.

Music Processing

When you're editing a composition with Dr. T's sequencer on the 64, the excellent Commodore full-screen editor is at your disposal. You can efficiently list, insert, copy, extend, move, delete, and otherwise *music process* the composition. All this is easy to learn because it's both familiar and logically arranged.

One of the most interesting features in Edit mode is called Transpose. You can modify an entire sequence all at once. The Transpose menu has six options: pitch, velocity, duration, autocorrect, compress/expand, and time reversal. You can instantly move an entire sequence to a different key. Autocorrect will smooth out the rhythm to whatever degree of perfection you specify. If you want your piece to sound like industrial funk, select an extreme resolve. The compress/expand option will speed up or slow down the tempo across the entire sequence.

Bach would have loved this: The time reversal option causes a sequence to fold over on itself, to play *backwards* while preserving the time values of all the notes. For some quick Baroque, create a copy of a sequence, time reverse it, and play the two together. If the results are harmonic, you've discovered a shortcut to mirror counterpoint.

It's easy to make various clock options and timing modifications, but you should make sure that this program supports whatever synthesizers you own. It does support the Yamaha, Sequential Circuits, Passport, and Korg interfaces. The Apple version uses the Passport interface. Dr. T also offers an interface by Sequential for the Commodore 64 for an additional $90. If you buy the software and the interface together, the total is $200.

When you add this excellent software plus an interface and synthesizer to your Commodore 64 or Apple, you become a one-person orchestra. You've got a set of well-designed, powerful tools to craft any kind of music. You can enter a composition by whatever method is easist for you, correct it to whatever degree of perfection suits you, and play it back through whatever instrument or combination of instruments sounds right.

Dr. T's Sequencer
Dr. T's Music Software
66 Louise Road
Chestnut Hill, MA 02167
Commodore Sequencer $125
Apple Sequencer $150

Commodore 3-D Animated Graphics

If you have attempted to type in the "3-D Graphics Package" program from this article in the November 1985 issue (p. 92), you have probably discovered that there is a problem when entering the data with MLX. The article does not mention that you must protect the upper portion of memory where the program data is stored before beginning to type the listing. Otherwise, the BASIC string variables created by MLX will overwrite your data as you enter it. Since the strings extend downward from the top of memory, the more data you type, the more you lose. Fortunately, the solution is quite simple. Before running MLX to enter 3-D Graphics Package data, enter the following line:

```
POKE 56,132:CLR
```

(That CLR is the BASIC CLeaR variables statement, not the clear screen character.) This protects the area of memory where the 3-D Graphics Package program is stored. You might consider adding this line as the first line of a special copy of MLX for the graphics package program.

Since any data you entered without protecting memory was overwritten, there is no way to recover any previous work; it will have to be retyped. It may be some small consolation that the new version of 64 MLX introduced last month and printed again this month will prevent this sort of problem from ever happening again. (But remember that the new MLX cannot be used to enter the data for the 3-D Graphics Package program.)

Commodore 64 Print Poker

This program, from the article "A Better Way to POKE on the Commodore 64" in the November 1985 issue (p. 125), was renumbered after testing. Unfortunately, no renumbering utility can adjust line number values in variables and PRINT statements as used in this program. To correct the "Print Poker" program so that it will correctly delete itself after running, change the RL= 60280 in line 60250 to RL=60270, the RL=60300 in line 60270 to RL=60290, the RL=60320 in line 60290 to RL=60310, the RL=60340 in line 60310 to RL=60330 and the PRINT"60135" in that line to PRINT"60190", the RL=60360 in line 60330 to RL=60350, and the PRINT"60390" in line 60350 to PRINT"60150". The PRINT"60105" in line 60350 can be eliminated, but it does no harm.

COMPUTE's Author Guide

Most of the following suggestions serve to improve the speed and accuracy of publication. COMPUTE! is primarily interested in new and timely articles on the Commodore 64/128, Atari, Apple, IBM PC/PCjr, Amiga, and Atari ST. We are much more concerned with the content of an article than with its style, but articles should be clear and well-explained.

The guidelines below will permit your good ideas and programs to be more easily edited and published:

1. The upper left corner of the first page should contain your name, address, telephone number, and the date of submission.

2. The following information should appear in the upper right corner of the first page. If your article is specifically directed to one make of computer, please state the brand name and, if applicable, the BASIC or ROM or DOS version(s) involved. In addition, *please indicate the memory requirements of programs.*

3. The underlined title of the article should start about 2/3 of the way down the first page.

4. Following pages should be typed normally, except that in the upper right corner there should be an abbreviation of the title, your last name, and the page number. For example: Memory Map/Smith/2.

5. All lines within the text of the article must be double- or triple-spaced. A one-inch margin should be left at the right, left, top, and bottom of each page. No words should be divided at the ends of lines. And please do not justify. Leave the lines ragged.

6. Standard typing paper should be used (no erasable, onionskin, or other thin paper) and typing should be on one side of the paper only (upper- and lowercase).

7. Sheets should be attached together with a paper clip. Staples should not be used.

8. If you are submitting more than one article, send each one in a separate mailer with its own tape or disk.

9. Short programs (under 20 lines) can easily be included within the text. Longer programs should be separate listings. *It is essential that we have a copy of the program, recorded twice, on a tape or disk.* If your article was written with a word processor, we also appreciate a copy of the text file on the tape or disk. Please use high-quality 10 or 30 minute tapes with the program recorded on both sides. The tape or disk should be labeled with the author's name, the title of the article, and, if applicable, the BASIC/ROM/DOS version(s). Atari tapes should specify whether they are to be LOADed or ENTERed. We prefer to receive Apple programs on disk rather than tape. Tapes are fairly sturdy, but disks need to be enclosed within plastic or cardboard mailers (available at photography, stationery, or computer supply stores).

10. A good general rule is to spell out the numbers zero through ten in your article and write higher numbers as numerals (1024). The exceptions to this are: Figure 5, Table 3, TAB(4), etc. Within ordinary text, however, the zero through ten should appear as words, not numbers. Also, symbols and abbreviations should not be used within text: use "and" (not &), "reference" (not ref.), "through" (not thru).

11. For greater clarity, use all capitals when referring to keys (RETURN, TAB, ESC, SHIFT), BASIC words (LIST, RND, GOTO), and three languages (BASIC, APL, PILOT). Headlines and subheads should, however, be initial caps only, and emphasized words are not capitalized. If you wish to emphasize, underline the word and it will be italicized during typesetting.

12. Articles can be of any length—from a single-line routine to a multi-issue series. The average article is about four to eight double-spaced, typed pages.

13. If you want to include photographs, they should be either 5×7 black and white glossies or color slides.

14. We do not consider articles which are submitted simultaneously to other publishers. If you wish to send an article to another magazine for consideration, please do not submit it to us.

15. COMPUTE! pays between $70 and $800 for published articles. In general, the rate reflects the length and quality of the article. Payment is made upon acceptance. Following submission (Editorial Department, COMPUTE! Magazine, P.O. Box 5406, Greensboro, NC 27403) it will take from four to eight weeks for us to reply. If your work is accepted, you will be notified by a letter which will include a contract for you to sign and return. *Rejected manuscripts are returned to authors who enclose a self-addressed, stamped envelope.*

16. If your article is accepted and you have since made improvements to the program, please submit an entirely new tape or disk and a new copy of the article reflecting the update. We cannot easily make revisions to programs and articles. It is necessary that you send the revised version as if it were a new submission entirely, but be sure to indicate that your submission is a revised version by writing, "Revision" on the envelope and the article.

17. COMPUTE! does not accept unsolicited product reviews. If you are interested in serving on our panel of reviewers, contact the Review Coordinator for details.

Disassembler 64

Ever wished you could disassemble a machine language program directly from disk? Now you can with this disassembler, which is written entirely in BASIC.

R.B. Miller

"Disassembler 64" is a modification of a PET/CBM program which appeared in the February 1982 issue of COMPUTE!. Like other disassemblers or monitor programs, it translates machine language (ML) from raw numbers into standard 6502/6510 mnemonics such as LDA and RTS. While most disassemblers only work with programs in memory, Disassembler 64 can disassemble a program or disk sector directly from the disk.

Type in Disassembler 64 and save it before running it for the first time. When you type RUN, the program asks whether you want to display the disassembly on the screen (S) or send it to a printer (P). Then the program asks whether you wish to disassemble an ML file (F) or a specific track and sector on the disk (T). If you choose to disassemble a file, you must then enter the filename as it appears in the disk directory. (Note that Disassembler 64 accepts only program (PRG) files.) After the file has been found, you're asked if you wish to skip the BASIC portion of a program. Some ML programs load as if they were written in BASIC and begin with a line such as 10 SYS 2061. This option lets you skip over the BASIC line and go directly to the ML.

Disassembler 64 then disassembles the entire file from disk. Press the space bar to pause the disassembly, or press Q if you want to quit. You may only disassemble forward: That is, once you have passed a certain section of the ML file, there is no way to back up and reexamine it. If you want to examine a previous section, you must quit the disassembly and start over again. Likewise, there is no way to begin disassembly midway through the file: You must start at the beginning and disassemble forward until you reach the part you want.

Occasionally you may find an ML program that does not appear on the directory. Such programs are loaded with direct access commands, which go to a specific track and sector rather than looking to the directory for the file location. If you can locate the beginning of such a program with a disk utility, Disassembler 64 permits you to disassemble it. After selecting this option, you must enter the track and sector numbers for the sector you want to disassemble. Then you are asked for the start address within that sector. Press RETURN at the prompt if you want to start at byte zero (the first byte in the sector).

As you may know, each sector of a disk file contains link information which indicates the location of the next sector for that file. Disassembler 64 keeps track of the sector links, permitting you to disassemble more than one sector if you wish. The manual for your disk drive contains more information about disk tracks and sectors.

Disassembler 64

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 POKE53272,21:POKE53281,1:PO
   KE53280,3:PRINT"{BLU}":GOTO
   330                        :rem 232
20 IFST-64THENRETURN          :rem 62
30 FG=1:RETURN                :rem 120
40 GETPA$:IFPA$=" "THENPA=NOTP
   A                          :rem 119
50 IFPATHEN40                 :rem 24
60 IFPA$="Q"THENFG=1:D=0
                              :rem 145
70 GET#5,D$:GOSUB20:IFD$=""THE
   ND=0:D$="00":RETURN:rem 126
80 D=ASC(D$):D$=H$(D):RETURN
                              :rem 115
90 A%=AD/B:AD$=H$(A%)+H$(AD-A%
   *B):RETURN                 :rem 203
100 A%=D/B:C$=H$(A%)+H$(D-A%*B
   ):RETURN                   :rem 47
110 IFFGTHENRETURN            :rem 189
120 GOSUB40:ONB%(D)GOTO140,160
   ,270:IFFGTHENRETURN :rem 5
130 D$=D$+"*":M$="":GOTO150
                              :rem 111
140 M$=M$(D)                  :rem 73
150 PRINT#DV," "AD$AD"
   {SHIFT-SPACE}"D$"
   {9 SPACES}"M$:AD=AD+1:GOSU
   B90:GOTO110                :rem 132
160 B1=D:B1$=D$:M$=M$(D)+" ":G
   OSUB70:ONA%(B1)GOTO170,180
   ,190,200,210,220,230
                              :rem 218
170 M$=M$+"# $"+D$:GOTO260
                              :rem 11
180 M$=M$+"Z $"+D$:GOTO260
                              :rem 67
190 M$=M$+"( $"+D$+",X)":GOTO2
   60                         :rem 46
200 M$=M$+"($"+D$+"),Y":GOTO26
   0                          :rem 39
210 M$=M$+"Z $"+D$+",X":GOTO26
   0                          :rem 48
220 M$=M$+"Z $"+D$+",Y":GOTO26
   0                          :rem 50
230 IFD<128THEND=AD+D+2:GOTO25
   0                          :rem 74
240 D=AD+D-254                :rem 211
250 GOSUB100:M$=M$+"$"+C$
                              :rem 38
260 PRINT#DV," "AD$AD" "B1$" "
   D$"{6 SPACES}"M$:AD=AD+2:G
   OSUB90:GOTO110             :rem 194
270 B1=D:B1$=D$:GOSUB70:B2$=D$
   :GOSUB70:M$=M$(B1)+" $"+D$
   +B2$                       :rem 194
280 ONA%(B1)GOTO320,290,300,31
   0                          :rem 117
```

```
290 M$=M$+",X":GOTO320:rem 181
300 M$=M$+",Y":GOTO320:rem 174
310 M$=LEFT$(M$,4)+"($"+D$+B2$
    +")"                    :rem 58
320 PRINT#DV,"{SHIFT-SPACE}"AD
    $AD" "B1$" "B2$" "D$"
    {3 SPACES}"M$:AD=AD+3:GOSU
    B90:GOTO110             :rem 60
330 CLOSE4:OPEN4,4:CLOSE3:OPEN
    3,3:GOSUB440            :rem 115
340 GOSUB500                :rem 172
350 GOSUB540:IFFSTHENGOSUB770
                            :rem 96
360 GOSUB570:IFFETHENFORI=1TO1
    0000:NEXT:POKE198,0:GOTO35
    0                       :rem 85
370 GOSUB610:GOSUB640       :rem 5
3B0 GOSUB110:IFFS<>0ANDNT<>0TH
    END=9:GOSUB7B0:GOTO400
                            :rem 33
390 PRINT#DV," ":PRINT#DV,"DIS
    SASSEMBLY COMPLETE":PRINT#
    DV," ":GOTO430          :rem 21
400 IFFY=0THEN430           :rem 245
410 TR=NT:SE=NS:GOSUB570:IFFET
    HEN350                  :rem 59
420 GOSUB640:FG=0:GOTO3B0
                            :rem 242
430 GOSUB730:GOTO340        :rem 187
440 B=256:DIMD$(15),H$(255),M$
    (255),B$(255),A$(255),C$(1
    5)                      :rem 63
450 FORJ=0TO15:READD$(J):NEXT
                            :rem 18
460 FORJ=0TO15:READC$(J):NEXT:
    PRINTCHR$(147)"{RVS}"C$(0)
    C$(10):PRINT"{DOWN}"C$(11)
                            :rem 84
470 PRINT"{DOWN}"C$(12)
                            :rem 152
480 FORJ=0TO15:FORD=0TO15:H$(J
    *16+D)=D$(J)+D$(D):NEXT:NE
    XT                      :rem 1B5
490 FORJ=0TO255:READM$(J),B$(J
    ),A$(J):NEXT:RETURN
                            :rem 202
500 D=1:GOSUB790:IFD$="S"THEND
    V=3:GOTO530             :rem 234
510 IFD$<>"P"THEN500        :rem 95
520 DV=4                    :rem 162
530 RETURN                  :rem 120
540 PRINT"{CLR}":D=2:GOSUB790:
    FS$=C$:IFFS$="T"THENFS=1:R
    ETURN                   :rem 138
550 IFFS$<>"F"THEN540       :rem 17B
560 FS=0:D=4:GOSUB790:FL$=D$:P
    RINT#DV," ":PRINT#DV,FL$:P
    RINT#DV," ":RETURN:rem 231
570 CLOSE5:CLOSE15:OPEN15,8,15
    :GOSUB830:IFFETHENRETURN
                            :rem 221
580 FS=FS+1:ONFSGOSUB590,600:F
    S=FS-1:RETURN           :rem 217
590 OPEN5,B,5,FL$+",P,R":GOSUB
    830:RETURN              :rem 132
600 OPEN5,B,5,"#":PRINT#15,"U1
    "5;0;TR;SE:GOSUB830:RETURN
                            :rem 94
610 IFFSTHEN630             :rem 135
620 GOSUB70:AD=D:AD$=D$:GOSUB7
    0:AD=AD+D*B:AD$=D$+AD$:RET
    URN                     :rem 58
630 D=3:GOSUB790:AD=INT(A%):AD
    $=D$                    :rem 205
640 PRINTCHR$(147):D=5:GOSUB79
    0:IFFY=0THEN710         :rem 251
650 IFFY-1THEN640           :rem 240
660 PRINTC$(0)C$(6):J=0
                            :rem 240
670 GET#5,D$:IFD$THENJ=J+1:GOT
    O670                    :rem 6
680 GET#5,D$:IFD$THENJ=J+2:GOT
    O670                    :rem B
690 GET#5,D$:IFD$THENJ=J+3:GOT
    O670                    :rem 10
700 AD=AD+J+3:GOSUB90       :rem 212
710 PRINTCHR$(147)C$(0)C$(7)"
    {2 DOWN}":PRINT"{DOWN}
    {7 RIGHT}PRESS SPACE BAR T
    O PAUSE                 :rem 4
720 PRINTSPC(12)"{DOWN}OR <Q>
    {SPACE}TO QUIT{2 DOWN}":FO
    RX=1TO600:NEXT:RETURN
                            :rem 60
730 FG=0:CLOSE5:CLOSE15
                            :rem 143
740 D=8:GOSUB790:IFFY=0THENPRI
    NT#4:CLOSE4:END         :rem 139
750 IFFY-1THEN740           :rem 242
760 RETURN                  :rem 125
770 D=14:GOSUB790:TR=INT(A%):D
    =15:GOSUB790:SE=INT(A%):RE
    TURN                    :rem 227
7B0 PRINT"{2 DOWN}{2 RIGHT}NEX
    T TRACK IS"NT"NEXT SECTOR
    {SPACE}IS"NS            :rem 7B
790 FY=2:PRINTC$(0)C$(D)"
    {3 LEFT}";:INPUTD$:IFD$="-
    "THEN790                :rem 143
800 A%=VAL(D$):C$=LEFT$(D$,1):
    IFC$="N"THENFY=0        :rem B4
810 IFC$="Y"THENFY=1        :rem 165
820 RETURN                  :rem 122
830 FE=0:INPUT#15,EN$,EM$,ET$,
    ES$:IFEN$="00"THENRETURN
                            :rem 236
B40 CLOSE4:PRINTC$(0)"{RVS}"C$
    (13):PRINTC$(0)EN$", "EM$"
    , "ES$","ET$:FE=1:RETURN
                            :rem 153
B50 DATA0,1,2,3,4,5,6,7,8,9,A,
    B,C,D,E,F,"{3 DOWN}
    {9 RIGHT}               :rem 115
860 DATASCREEN / PRINTER
    {2 SPACES}S,T/S OR FILE
    {2 SPACES}<T/F>{3 SPACES}F
    ,"START ADDR{3 SPACES}0000
    {3 LEFT}                :rem 24B
870 DATAFILENAME{2 SPACES}-,SK
    IP BASIC PROGRAM{3 SPACES}
    N                       :rem 82
880 DATASKIPPING BASIC....,DIS
    ASSEMBLING....          :rem 226
890 DATADISASSEMBLE ANOTHER FI
    LE{3 SPACES}N,DO NEXT T $
    {SPACE}S{3 SPACES}Y,DISK U
    NASSEMBLER 64           :rem 13B
900 DATA-BASIC DISASSEMBLER FO
    R C64 DISK FILES-       :rem 31
910 DATAOUTPUT RESEMBLES ASSEM
    BLER SOURCE CODE.,DISK ERR
    OR.....                 :rem 244
920 DATA"WHICH TRACK{3 SPACES}
    18{LEFT}",WHICH SECTOR
    {3 SPACES}0             :rem 134
930 DATABRK,1,,ORA,2,3,,,,,,,,
    ,,ORA,2,2,ASL,2,2,,,
                            :rem 139
940 DATAPHP,1,,ORA,2,1,ASL A,1
    ,,,,,,,,ORA,3,1,ASL,3,1,,,
                            :rem 229
950 DATABPL,2,7,ORA,2,4,,,,,,,
    ,,,ORA,2,5,ASL,2,5,,,
                            :rem 203
960 DATACLC,1,,ORA,3,3,,,,,,,,
    ,,,ORA,3,2,ASL,3,2,,,
                            :rem 132
970 DATAJSR,3,1,AND,2,3,,,,,,,
    BIT,2,2,AND,2,2,ROL,2,2,,,
                            :rem 4
980 DATAPLP,1,,AND,2,1,ROL A,1
    ,,,,,BIT,3,1,AND,3,1,ROL,3
    ,1,,,                   :rem 44
990 DATABMI,2,7,AND,2,4,,,,,,,
    ,,,AND,2,5,ROL,2,5,,,
                            :rem 184
1000 DATASEC,1,,AND,3,3,,,,,,,
    ,,,AND,3,2,ROL,3,2,,,
                            :rem 158
1010 DATARTI,1,,EOR,2,3,,,,,,,
    ,,,EOR,2,2,LSR,2,2,,,
                            :rem 21B
1020 DATAPHA,1,,EOR,2,1,LSR A,
    1,,,,,JMP,3,1,EOR,3,1,LSR
    ,3,1,,,                 :rem 113
1030 DATABVC,2,7,EOR,2,4,,,,,,
    ,,,,EOR,2,5,LSR,2,5,,,
                            :rem 7
1040 DATACLI,1,,EOR,3,3,,,,,,,
    ,,,EOR,3,2,LSR,3,2,,,
                            :rem 201
1050 DATARTS,1,,ADC,2,3,,,,,,,
    ,,,ADC,2,2,ROR,2,2,,,
                            :rem 174
1060 DATAPLA,1,,ADC,2,1,ROR A,
    1,,,,,JMP,3,4,ADC,3,1,ROR
    ,3,1,,,                 :rem 6B
1070 DATABVS,2,7,ADC,2,4,,,,,,
    ,,,,ADC,2,5,ROR,2,5,,,
                            :rem 225
10B0 DATASEI,1,,ADC,3,3,,,,,,,
    ,,,ADC,3,2,ROR,3,2,,,
                            :rem 156
1090 DATA,,,STA,2,3,,,,,,,STY,
    2,2,STA,2,2,STX,2,2,,,
                            :rem 56
1100 DATADEY,1,,,,,TXA,1,,,,,S
    TY,3,1,STA,3,1,STX,3,1,,,
                            :rem 20
1110 DATABCC,2,7,STA,2,4,,,,,,
    ,STY,2,5,STA,2,5,STX,2,6,
    ,,                      :rem 109
1120 DATATYA,1,,STA,3,3,TXS,1,
    ,,,,,,,STA,3,2,,4,,,,
                            :rem 240
1130 DATALDY,2,1,LDA,2,3,LDX,2
    ,1,,,,LDY,2,2,LDA,2,2,LDX
    ,2,2,,,                 :rem 110
1140 DATATAY,1,,LDA,2,1,TAX,1,
    ,,,,LDY,3,1,LDA,3,1,LDX,3
    ,1,,,                   :rem 19
1150 DATABCS,2,7,LDA,2,4,,,,,,
    ,LDY,2,5,LDA,2,5,LDX,2,6,
    ,,                      :rem 37
1160 DATACLV,1,,LDA,3,3,TSX,1,
    ,,,,LDY,3,2,LDA,3,2,LDX,3
    ,3,,                    :rem 37
1170 DATACPY,2,1,CMP,2,3,,,,,,
    ,CPY,2,2,CMP,2,2,DEC,2,2,
    ,,                      :rem 47
11B0 DATAINY,1,,CMP,2,1,DEX,1,
    ,,,,CPY,3,1,CMP,3,1,DEC,3
    ,1,,,                   :rem 1B
1190 DATABNE,2,7,CMP,2,4,,,,,,
    ,,,,CMP,2,5,DEC,2,5,,,
                            :rem 215
1200 DATACLD,1,,CMP,3,3,,,,,,,
    ,,,CMP,3,2,DEC,3,2,,,
                            :rem 145
1210 DATACPX,2,1,SBC,2,3,,,,,,
    ,CPX,2,2,SBC,2,2,INC,2,2,
    ,,                      :rem 38
1220 DATAINX,1,,SBC,2,1,NOP,1,
    ,,,,CPX,3,1,SBC,3,1,INC,3
    ,1,,,                   :rem 21
1230 DATABEQ,2,7,SBC,2,4,,,,,,
    ,,,,SBC,2,5,INC,2,5,,,
                            :rem 211
1240 DATASED,1,,SBC,3,3,,,,,,,
    ,,,SBC,3,2,INC,3,2,,,,END
                            :rem 159
```

HOTWARE: Software Best Sellers

This Month	Last Month	Title	Publisher	Remarks	Systems: Apple	Atari	Commodore	IBM	Macintosh
Entertainment									
1.	2.	*F-15 Strike Eagle*	MicroProse	Air combat simulation	●	●	●	●	
2.	4.	*Flight Simulator II*	SubLogic	Aircraft simulation	●	●	●		
3.		*Jet*	Subtlogic	Flight simulation	●	●	●		
4.	1.	*Goto*	Spectrum Halabyte	Submarine simulation	●			●	●
5.	3.	*Koroteko*	Brøderbund	Action karate game	●	●	●		
Education									
1.	2.	*Typing Tutor III*	Simon & Schuster	Typing instruction program	●		●	●	●
2.	1.	*Moth Blaster!*	Davidsan	Introductory math program, ages 6-12	●	●	●	●	
3.	3.	*New Improved MasterType*	Scarborough	Typing instruction program	●	●	●	●	●
4.	4.	*Music Construction Set*	Electronic Arts	Music compasition pragram	●	●	●		
5.	5.	*Sky Trovel*	Commodore	Astronomy learning program			●		
Home Management									
1.	1.	*Print Shop*	Brøderbund	Do-it-yourself print shap	●	●	●		
2.	2.	*The Newsroom*	Springbaard	Da-it-yaurself newspaper	●		●	●	
3.		*Poper Clip*	Batteries Included	Word pracessor	●	●	●		
4.	3.	*Print Shop Graphics Library II*	Brøderbund	Upgraded graphics library	●	●	●		
4.	4.	*Print Shop Grophics Library*	Brøderbund	100 additianal graphics	●	●	●		

Introduction To AmigaDOS

Part 1

Charles Brannon, Program Editor

Amiga's Workbench, like the Macintosh desktop, is an easy to use operating system environment. Workbench gives you almost full access to the Amiga's features without requiring that you memorize commands. But there's another option on the Amiga, too: AmigaDOS, a more conventional and very powerful command-oriented operating system. Here's a guide to getting started with AmigaDOS.

The Commodore Amiga comes with a large looseleaf binder packed with information on this advanced computer. Even if you've never used a graphics-oriented operating system before, you can plug in the mouse and be up and running on the Amiga Workbench in very little time.

But there's something missing from the standard manuals: instructions for using AmigaDOS, a powerful alternative to the Workbench. Although the Workbench is a versatile tool for both beginners and expert users, there are also advantages to a command-driven operating system. With AmigaDOS, you can gain finer control over the computer and its many functions—at the expense of having to memorize dozens of commands and their proper syntax. These tradeoffs have been a subject of hot debate ever since the Macintosh made its debut three years ago. Fortunately, the Amiga gives you both options. And thanks to its multitasking capabilities, you can even flip back and forth between both systems at will.

All this is made possible by the Amiga's multilevel operating system. The core is Intuition, a package of efficient subroutines designed to ease the software designer's task. It's filled with routines needed by almost every program, saving programmers the trouble of reinventing the wheel. Intuition includes powerful graphics utilities so programmers needn't program the computer at the hardware level.

Pay No Attention To The Little Man

Attached to the Intuition core is AmigaDOS, which itself has two levels. First, AmigaDOS provides all the disk operating system functions for the computer, such as managing, opening, accessing, updating, and closing files; buffering direct memory access (DMA) for the disk drives; supporting named devices; and allocating memory.

Second, AmigaDOS as a *tool* provides one or more Command Line Interfaces (CLIs). A CLI is a traditional command-oriented operating system interface, much like CP/M, MS-DOS, and PC-DOS—but even more powerful. At a screen prompt, you can type in commands to load and run programs, list disk directories, copy, rename, and delete files, and even write simple programs called batch files.

When you start the Workbench, AmigaDOS comes with it. In fact, you've undoubtedly seen the AmigaDOS screen briefly appear when you first boot up the Workbench disk. AmigaDOS comes up first, loads the Workbench, then shuts down its CLI, transferring control to the Workbench.

AmigaDOS is like the Wizard of Oz. It pulls the strings of the marionette that is the Workbench. Meanwhile, hidden from sight, AmigaDOS is doing much of the work. When you step behind the curtain, you see how things are really done. Once the object-oriented illusion of the Workbench is stripped away, you find yourself working with files, streams, subdirectories, and pathnames.

Starting A CLI

To start an AmigaDOS CLI, first run the Preferences tool by opening up the Workbench disk and double-clicking on the Preferences icon. The Preferences screen (see photo) has an option box labeled CLI [ON] [OFF]. Click the box ON, then click on either USE or SAVE, depending on whether you'd like the CLI option available whenever you start the Workbench in the future.

With CLI enabled, open the Workbench's System folder. In addition to the usual icons for Disk Copy and Initialize, you'll see a cube-shaped icon marked with 1> and labeled CLI. Double-click on this icon to open a CLI window.

The first thing you'll notice in the window is the 1> prompt. Unlike DOS prompts on most other computers, this doesn't represent the current disk drive. Instead, it represents the *task number* assigned to the window. AmigaDOS is one of the few microcomputer operating systems that can multitask itself.

To see how this works, enter NEWCLI at the 1> prompt. When you press RETURN, a second CLI window pops up with the prompt 2>. This CLI is a complete, full-

powered CLI, independent from the first CLI. In effect, you now have two command-driven operating systems running on the computer. Each window can execute a different DOS task. While one CLI is busy printing a file, you can go to another CLI window to list a directory.

Although several CLI windows can be displaying output simultaneously, only one CLI window at a time can accept input. To select which CLI is *active*, point to its window and click the mouse button. You can distinguish active from inactive windows by glancing at the title bars—the bar of an inactive window is dimmed.

If you type NEWCLI at the 1> or 2> prompt, a third CLI window opens with a 3> prompt. How many CLI windows can be opened at once? On a 512K Amiga, we've opened as many as 20 CLIs before encountering an out-of-memory message.

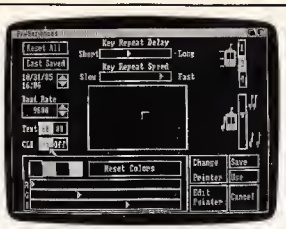
When you're done with a CLI, close it by entering ENDCLI. When you close the primary CLI, control reverts to the Workbench.

AmigaDOS Devices

For any DOS commands to work, the startup (Workbench) disk must be in the current drive. Unlike other operating systems, AmigaDOS contains no memory-resident commands. All commands are *extrinsic*—they're loaded from disk only when called. AmigaDOS always looks for commands first from the current directory, then the C subdirectory on the SYS: (startup) disk. We'll elaborate on this in a moment.

You can type AmigaDOS commands and filenames in either upper- or lowercase (for clarity, all our examples are shown in uppercase). If you make any typing mistakes, you can press BACKSPACE or cursor-left to retype. Type CTRL-X to erase the whole line. You can get a complete list of all commands by typing DIR SYS:C. This shows the contents of the C subdirectory on the startup disk, the directory where all AmigaDOS commands are stored.

The DIR command displays the current directory. By default, the current directory is listed from the internal drive, which is referred



To allow access to AmigaDOS from the Workbench, click the mouse button with the pointer positioned upon the CLI [ON] box within the Preferences screen.

to as DF0:. If you have a multiple-drive system, you can get a directory of the first external drive by typing DIR DF1:. Up to three external drives can be daisy-chained, numbered DF1: to DF3:. The colon following the drive name is important—it tells AmigaDOS that it is a *device name* rather than the name of a file.

A special device, SYS:, refers to the system (startup) disk. Although the startup disk is usually in drive DF0:, SYS: is not necessarily synonymous with DF0:. SYS: refers to the startup *disk*, not a *drive*.

Disk Names

Instead of referring to a physical drive, you can access a disk by name. When you use Workbench to copy or format a new disk, the disk is assigned a unique name, which is displayed beneath the disk icon on the Workbench screen. When specifying a disk name in a command, you must end it with a colon, as you do with device names. If the disk is not in a drive when you refer to it in a command, AmigaDOS prompts you to insert it.

The ability to specify disk names is vital with single-drive Amigas. When you type DIR, the DIR program is loaded from the Workbench disk and displays the directory of that disk. If you insert another disk and type DIR, you have to reinsert the Workbench disk so AmigaDOS can read the DIR file. Unfortunately, AmigaDOS doesn't ask you to put the other disk back in—so you still get the directory of the Workbench disk.

The solution? Follow the DIR command with the proper disk name. For example, DIR "BASIC Demos:" (remember the colon) calls a directory of the disk named BASIC Demos. AmigaDOS still loads the DIR command file from the Workbench disk, but now asks you to insert "BASIC Demos" before displaying the directory. Specifying the disk name (also known as a *volume name*) forces AmigaDOS to refer to a *disk* instead of a *drive*.

Other device names are PAR: for the parallel printer port, SER: for the serial/modem port, PRT: for whatever printer port you've specified via the Preferences tool, and RAM: for the RAM disk. Another device, NIL:, is a null handler. It accepts output instantly, but does nothing with it. The NIL: device is useful for testing a program without wasting paper or time—just redirect the output to NIL:.

The RAM disk behaves just like a superfast disk drive, except that its contents are lost when the computer is rebooted or turned off. Be sure to copy anything important from the RAM disk to a real disk before shutting down, or even more frequently if power failures and brownouts are common in your area. The RAM disk is dynamic: Unlike some RAM disks, it has no fixed size. It starts out empty, then grows or shrinks as you add or remove files. Therefore, it's always 100 percent full, using only as much memory as it needs to hold the files you've stored there.

Whenever you want to refer to the RAM disk in an AmigaDOS command, just precede a filename with the prefix RAM:. At present, the RAM disk isn't accessible from the Workbench.

Another special device name, *, refers to the current keyboard/screen device. Input from * is from the keyboard; output to * appears in the current window. Notice that this is different from the use of * as a wildcard character in some other operating systems.

Understanding Pathnames

A *file* is the basic data storage object in AmigaDOS. A file is addressed by a *filename*, a string of up to 30 characters. Each file must have a unique filename. Filenames can include almost any character, including characters such as space, =, +,

and ", special AmigaDOS delimiters that you should avoid. (If a file contains special characters, you can enclose it in quotes to make sure the special characters aren't acted upon by AmigaDOS.) However, two characters are forbidden in filenames by AmigaDOS—the colon (:) and the slash (/).

Each drive has its own *directory*, a list of all filenames and subdirectory names. A *subdirectory* is a directory within a directory. Subdirectories are like drawers on the Workbench. You can even nest subdirectories within subdirectories within subdirectories, which can get confusing.

You separate a subdirectory name from a filename with the slash (/). Notice that this slash leans in the opposite direction of the backslash (\) used in IBM PC-DOS for subdirectories.

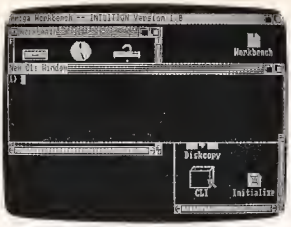
A complete filename can be as simple as PROCEDURES, equivalent to DF0:PROCEDURES, since DF0: is the default drive. Filenames can also be a lot more complicated, such as DF1:BASIC PROGRAMS/GIDGET, which refers to the program GIDGET in the subdirectory BASIC PROGRAMS on the external drive, or RAM:LOGO/DEMOS/SPINNER, which refers to the file SPINNER in the DEMOS subdirectory which is in the LOGO subdirectory in the RAM disk.

Fortunately, there are shortcuts. Instead of entering the current pathname, such as DF0:DEMOS/DOTS.INFO, it's sufficient to use DOTS.INFO if the current directory is DF0:DEMOS. We'll show below how to change the current directory.

More About Multitasking

You can do nearly everything with AmigaDOS that you can with the Workbench. There are commands to copy files, delete files, rename files, format disks, send listings to printers, set date and time, and more. You can also run any application program from AmigaDOS.

All Workbench programs have two files: one file that contains the program, and another file with an extension of .INFO that contains icon information for the program. For instance, the icon for the Preferences tool is drawn from PREFERENCES.INFO. To run the Preferences tool from AmigaDOS, enter PREFERENCES at a CLI prompt. Similarly, enter CLOCK to start the clock tool.



Clicking on the CLI icon from the Workbench opens up this AmigaDOS screen window.

Be careful not to let the program you're running override the CLI. If you'd like to keep the CLI going while running another program, preface the AmigaDOS command with another command, RUN. This starts a new, simultaneous program. RUN CLOCK starts the clock while permitting the CLI to continue running. The clock becomes a new CLI task. We've used this feature on a 512K Amiga to run MetaComCo ABasiC simultaneously with AmigaDOS, the Workbench, and a full-screen editor.

AmigaDOS Commands

Following is a list of AmigaDOS commands with brief descriptions and examples. There isn't enough space to include every command—more will be covered in Part 2. Also, some commands shown here may not be available on your copy of AmigaDOS/Workbench, while there may be other commands available to you that have not been documented. This article was prepared with AmigaDOS version 1.0. Type DIR SYS:C at a CLI prompt to see a complete list of available commands. When experimenting with AmigaDOS commands, we strongly recommend using a scratch disk to avoid wiping out an important file or even a whole disk.

CD *(Change Directory.)* Follow CD with the pathname of the directory you'd like to work with. Entering CD by itself displays the current search path. When you type a command, AmigaDOS first searches for the extrinsic command file in your current directory, then in the C DIR directory. AmigaDOS also looks for all filenames in the current directory, unless you override the current directory with another pathname.
Example:

```
CD DF1:BASIC
```

This switches the current directory to the first external drive and the subdirectory BASIC.

COPY This copies a file or group of files to any legal destination. The keyword TO specifies the destination path. You can use the optional keyword FROM to specify a directory other than the current directory. If you are copying entire subdirectories, append the keyword ALL so that COPY creates a subdirectory in the destination directory. COPY normally displays the name of each file as it's copied. Append the keyword QUIET if you'd like to suppress this.
Examples:

```
COPY MATRIX.SORT TO DF1:
  MATRIX.BKP
```

This copies the file MATRIX.SORT in the current directory, creating a file called MATRIX.BKP in the main directory of the first external drive.

```
COPY FROM DF1:GOBBLE TO DF0:
```

This copies the file GOBBLE from the external drive to the internal drive.

```
COPY DF0: TO DF1: ALL
```

This backs up the entire contents of the internal drive onto the external drive, including the contents of all subdirectories. COPY doesn't format the destination disk, so DISKCOPY is a more convenient way of backing up an entire disk.

```
COPY SYS:C TO RAM: QUIET
```

This copies the command directory to the RAM disk without listing all the filenames.

```
COPY * TO PRT:
```

This accepts lines from the keyboard and prints them on the printer until CTRL-\ is pressed.

DATE This command sets the current date and time. When you create or update a file, AmigaDOS stamps the date and time on the directory. Since there's no battery-backup for the clock, however, the Amiga doesn't know this information until you tell it. By default, AmigaDOS assumes the date

stamped on the most recent file. Entering DATE by itself displays the current date.

To set the date from AmigaDOS without running the Preferences tool, follow the DATE command with a date in the form DD-MMM-YY (e.g. 25-DEC-85). To set the time, follow this with the form HH:MM (using 24-hour time, such as 13:00 for 1 p.m.). You can type DATE TOMORROW to advance the date ahead one day, or DATE YESTERDAY to back up one day. Another shortcut is to simply enter DATE *dayname*, as in DATE TUESDAY. If you use your Amiga frequently, this may be all you need to keep things up to date.

An interesting application of the DATE command is to determine which day of the week a certain date falls on. For example, DATE 25-DEC-86 sets the date to Christmas Day, 1986. If you then enter DATE by itself, AmigaDOS displays THURSDAY 25-DEC-86, letting you know that Christmas falls on a Thursday in 1986.
Examples:

DATE 04-JUL-76

This sets the current date to July 4, 1976. (The Amiga assumes you know which century you're living in, so there's no way to specify 1776 versus 1976 or 2076.)

DATE 08:30 FRIDAY

This sets the time to 8:30 a.m. and advances the date to Friday. DATE FRIDAY 08:30 would also work.

DELETE This command deletes a file or group of files. Follow DELETE with the pathname specifying a file. You cannot delete a subdirectory if it contains any files. You can delete several files by separating each one with a comma, up to a maximum of ten. DELETE doesn't ask ARE YOU SURE?, so be careful.
Examples:

DELETE MASTER.BKP

This deletes the file MASTER.BKP from the current directory.

DELETE DF1:PROGS/ALPHA,OMEGA

This deletes the file ALPHA on the PROGS subdirectory on the external drive, and also deletes the file OMEGA from the current directory.

DIR *(Directory)* DIR and LIST are similar commands. DIR lists just file and directory names, while LIST gives additional information (see LIST). Follow DIR by a legal directory path. Don't include the name of a file in the path. The OPT command permits special directory options. DIR OPT A lists the contents of any subdirectories along with the main directory. DIR OPT D lists only subdirectory names.

There is a special interactive directory mode which you enter with DIR OPT I. While in directory mode, the entries are displayed one at a time. Press RETURN to go on to the next entry. If the entry is a subdirectory name, you can press E to enter that subdirectory, listing its files. To exit a subdirectory, enter B. If the current entry is a file, you can type T to type its contents (CTRL-C aborts the display). You can enter the command DEL to delete the current entry (again, you can't delete a directory unless it's empty). Type Q to quit the interactive mode.
Examples:

DIR

This displays the current directory.

DIR DF1:DEMOS

This displays the contents of subdirectory DEMOS on the external drive.

DIR DF1: OPT A

This displays the directory and the directory of next-level subdirectories on the external drive.

DISKCOPY To copy one disk to another with two drives, enter DISKCOPY DF0: TO DF1:. Formatting is automatic, and the copy has the same name as the original unless you use the NAME option, as in DISKCOPY DF0: TO DF1: NAME "KICKSTART BACKUP". To copy a disk with one drive, type DISKCOPY DF0: TO DF0:. You'll be prompted to alternately insert the original and destination disks.
Examples:

DISKCOPY DF1: TO DF0:

This backs up the disk in the external drive to the disk in the internal drive. Although both disks will have the same name, AmigaDOS can distinguish between them by the dates they were created.

DISKCOPY DF0: TO DF0: NAME "WORKBENCH BACKUP"

This creates a named backup of the disk in the internal drive. Several disk swaps are required.

ENDCLI This cancels the current CLI window. Use this command only to terminate a secondary CLI or to return to the Workbench. If there is no Workbench and you close the primary CLI, everything ends, leaving you nothing to work with. Your only recourse would be to reboot the system.

FORMAT This lets you format a new disk. Follow FORMAT with the keyword DRIVE (required), a drive device, the keyword NAME, and a unique 30-character disk name (enclosed in quotes if it contains any spaces). FORMAT customizes a blank disk for use with the Amiga drives. Don't forget that FORMAT irreversibly erases everything on the disk.
Example:

FORMAT DRIVE DF0: NAME "FINAL PROTOTYPE"

LIST This command gets you more information about a disk, directory, or file. LIST by itself displays the current directory. LIST can also be followed by a directory path and/or a filename. LIST followed by a filename gives information only for that file. For each file, LIST displays the filename, size in bytes, file access (Readable/Writeable/Executable/Deletable), the date stamp, and the comment, if one was specified with the FILENOTE command (FILENOTE uses the form FILENOTE *filename "comment."*).

LIST can also be used with the keyword TO, which can redirect the listing to another device, such as the printer. With DATES, LIST displays dates as DD-MMM-YY, which is the default unless you use NODATES. You can use SINCE followed by a date to show only those files written on or after the specified date, or UPTO to list only those files created before or on the specified date. (The date follows the same format used by the DATE command).
Examples:

LIST DF1: SINCE YESTERDAY

This displays the main directory of the external drive, including only those files which were created yesterday or today.

MAKEDIR *(Make directory)* Follow MAKEDIR with a new directory path. The last directory name in the

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path is the name of the new directory.
Examples:

MAKEDIR "AIR MAIL"

This creates a new subdirectory called "AIR MAIL" (quotes used because name contains spaces) on the current directory.

MAKEDIR DF1:DEMOS/GRAPHICS

This creates a new subdirectory called GRAPHICS within the existing subdirectory DEMOS on the disk in the external drive.

NEWCLI By itself, NEWCLI just opens up a new CLI window and transfers keyboard control to it. The original CLI is retained. You can use the mouse to move and resize the window, as usual. This new CLI can use different settings than other CLIs, such as a unique current directory. A CLI can work in the background while you switch to another process. You can customize a CLI by following it with "CON: *x/y/width/height/title*", which lets you specify the starting position, size, and name of the new CLI window.

Although not documented, it's possible to control a CLI with another device. NEWCLI SER:, for example, starts a CLI controlled by an RS-232 device, such as a modem or terminal. This could let a remote user control his own independent DOS console.

Use ENDCLI to cancel a CLI and revert to a former one.
Example:

NEWCLI "CON:320/100/160/50/ EXTERNAL DRIVE"

This creates a 160 × 50-pixel window at position 320,100 with the name "EXTERNAL DRIVE". This new window is a complete CLI. With the CD command, you can set up this window to access one drive, and a different window to access another. The parameters of the CON: device, shown here, can be used as the output of other commands as well.

PROTECT This command sets a file's protection status. Follow PROTECT by the filename, the optional keyword STATUS, and the protection desired: r to allow a file to be read, w to allow a file to be written to, d to make a file deleteable, and e to make the file executable. To protect a file against a certain type of access, omit the corresponding letter. Only actual machine-runnable object code programs should be made executable.
Examples:

PROTECT YUPPIES

This makes the file YUPPIES practically nonexistent. It shows up on the directory, but it cannot be read, written to, deleted, or executed. You can use PROTECT again to override this, of course.

PROTECT "DON'T READ ME" STATUS WD

This allows the file "DON'T READ ME" to be written to and deleted, but not read or executed. PROTECT provides a simple form of protection, since it can always be used to change the file's status back. It mainly protects you against your own mistakes.

RENAME Follow RENAME with the optional keyword FROM, the existing name of the file, the optional keyword TO or AS, and the name you'd like to change it to. The new name must not conflict with any existing name. The position occupied by that file on the directory may change after the rename, especially if you use a different subdirectory name for the new name.
Examples:

RENAME FROM "Templates/Amortization" TO "Templates/32yr Amortz"

This changes the name of file Amortization to "32yr Amortz" within the subdirectory Templates.

RENAME Dog AS Cat

This changes file Dog to Cat within the current directory.

RENAME FROM Progs/Slither TO Pascal/Slither

By changing Slither's subdirectory name, we have, in effect, moved Slither from the Progs directory to the Pascal directory. (This is similar to the usage of mv in the Unix operating system.)

RUN This lets you run any executable file "in the background," that is, while another task is running. RUN is the AmigaDOS multitasking command. If you start an object module or command by just typing its name, it takes over control from AmigaDOS. Some commands don't return to AmigaDOS when they end, locking you out of the CLI. RUN lets you run any command or program as an independent, simultaneous process, just as NEWCLI creates a simultaneous CLI. You can run multiple commands and programs by ending each line with a + sign to specify a continuation to the next line.
Example:

RUN ed Simple

This starts the full-screen editor with the file Simple. Meanwhile, the CLI is still running. To get to it, use the mouse to select the current screen's back gadget to display AmigaDOS, then click in the AmigaDOS window to activate the CLI. You can type in the AmigaDOS window, executing commands, then switch to Ed to continue editing. Without RUN, Ed takes over until you exit.

TYPE This command prints out a file on the screen. It's generally used with text files. Displaying other types of files usually produces nonsensical streams of strange characters. Follow TYPE with the filename. To redirect TYPE to another device, include the TO option, as in TYPE README.DOC TO PRT:.

TYPE allows two options. TYPE OPT N creates sequential line numbers for each line of text. You could use TYPE SAMPLE TO "NUMBERED SAMPLE" OPT N to create a line-numbered version of SAMPLE as "NUMBERED SAMPLE". TYPE OPT H displays the characters in a file as hexadecimal numbers. This is more useful when displaying machine language code or data files.
Examples:

TYPE "DF1:BASIC PROGRAMS/ PINPOINT"

This displays the BASIC program PINPOINT located in the subdirectory BASIC PROGRAMS in the external drive. In this case, quotes are required to prevent the embedded space in BASIC PROGRAMS from terminating the TYPE command.

TYPE SYS:C/DIR OPT H

This displays the contents of the DIR command (which is stored as a file in SYS:C) in hexadecimal. (Unless you can mentally disassemble the hex dump into 68000 mnemonics, this file will make no sense.)
Next month, Part 2 covers more commands in the powerful AmigaDOS.©

Formatted Printouts For Commodore

Todd Touris

Anyone who's written a BASIC program or typed one in from a magazine knows how difficult it can be to decipher the listing. This utility for Commodore computers makes those listings much easier to read. A printer and disk drive are required.

If you own a printer and a Commodore computer, you probably know how to print out a BASIC program listing. Just load the program into memory, type OPEN 4,4:CMD4: LIST and press RETURN. However, printed listings can be difficult to follow, particularly when program lines contain more than one statement. "Formatted Printouts" is a utility program which improves the readability of BASIC listings, making them easier for you and others to understand.

Type in the program below and save a copy before you run it. It's designed for Epson and Epson-compatible printers. If you have a different printer (Commodore, etc.), minor changes may be needed. The first few lines of the program define several strings for sending control codes to the printer for special modes such as boldface, underlining, and so on. REM statements explain the purpose of each string. Your printer manual should explain which codes to substitute within these strings.

If you're using a VIC-20, you must have at least 8K of memory expansion, and you must also change the following lines:

```
60 POKE36879,8          :rem 10
70 PRINTCHR$(14)"{CLR}{WHT}
   {RVS} PRETTY PRINTER {OFF}"
                        :rem 55
80 PRINT"{8 DOWN}PLEASE WAIT O
   NE MOMENT            :rem 192
130 PRINT"FILENAME TO PRINT";I
    NPUTN$              :rem 146
```

Commodore Plus/4 and 16 users should ignore the :rem statements at the end of each line. These are used with the VIC and 64 "Proofreader" program. Also, with those computers, you need to replace line 60 with this line:

```
60 COLOR 0,1:COLOR 4,1
```

The program is self-prompting and very simple to use. Insert the disk that contains the BASIC program you want to list, then enter the program filename when prompted. That's all it takes. When a program line contains multiple statements, each statement appears on a separate line. Every BASIC keyword (PRINT, GOTO, etc.) is capitalized and printed in boldface. REM lines are underlined, and special graphics characters within quotes are printed as a descriptive string within brackets. For example, the "cursor down" character is printed as **[crsr down]**.

There's one final feature that should be appreciated by those who have used structured languages such as Pascal. All statements inside a FOR-NEXT loop, or after an IF-THEN conditional statement, are indented two spaces, making it much easier to follow the logic of each section. Since this program is written entirely in BASIC, it should not be difficult to add any other features you might desire.

Formatted Printouts For Commodore

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 DIM CHAR$(255),KEYWRD$(75)
                        :rem 77
20 NULL$=CHR$(0):ESC$=CHR$(27)
                        :rem 177
30 S$=ESC$+"E":E$=ESC$+"F":REM
    EMPHASIZED PRINT MODE FOR
   {SPACE}KEYWORDS      :rem 119
40 RS$=ESC$+"-"+CHR$(1):RE$=ES
   C$+"-"+NULL$:REM UNDERLINE
   {SPACE}FOR REM COMMENTS
                        :rem 255
50 SC$="[":EC$="]":REM BRACKET
   S FOR SPECIAL CHARACTER STR
   INGS                 :rem 203
60 POKE53281,11:POKE53280,12
                        :rem 32
70 PRINTCHR$(14)"{CLR}{WHT}
   {RVS}{13 SPACES}PRETTY PRIN
   TER{13 SPACES}{OFF}":rem 55
80 PRINT"{8 DOWN}{8 SPACES}PLE
   ASE WAIT ONE MOMENT..."
                        :rem 108
90 FORL=0TO255:CHAR$(L)=CHR$(L
   ):NEXTL              :rem 1
100 FORL=0TO31:READCHAR$(L):NE
    XTL:FORL=129TO159:READCHAR
    $(L):NEXTL          :rem 180
110 FORL=0TO75:READKEYWRD$(L):
    NEXTL               :rem 243
120 PRINT"{UP}{38 SPACES}"
                        :rem 245
130 INPUT"FILENAME TO PRINT";N
    $                   :rem 6
140 OPEN8,8,8,N$+",P,R":OPEN4,
    4,7:GOSUB290        :rem 134
150 IFLN<>2049THENPRINT"THIS I
    S NOT A BASIC PROGRAM":CLO
    SE8:CLOSE4:GOTO130 :rem 91
160 NSP=0:FOF=0         :rem 119
170 REM MAIN ROUTINE    :rem 199
180 GOSUB290:IFLN=0THEN470
                        :rem 78
190 GOSUB290:LS$=STR$(LN)+" ":
    NSP=NSP-COF:COF=0:LL=LEN(L
    S$):GOTO210         :rem 75
200 LS$="":FORL=1TOLL:LS$=LS$+
    " ":NEXTL           :rem 29
210 GOSUB310            :rem 167
220 IFB>127THENGOSUB380:GOTO26
    0                   :rem 146
```

```
230 IFB=34THENGOSUB8330:GOTO270
                              :rem 91
240 IFB$=":"THENA$=A$+B$:GOSUB
    450:GOTO200          :rem 101
250 IFB=0THENGOSUB8450:GOTO180
                              :rem 41
260 IFB=167THENGOSUB450:GOTO20
    0                     :rem 145
270 A$=A$+B$:GOTO210      :rem 55
280 REM LINE NUMBER RETRIEVAL
    {SPACE}ROUTINE        :rem 67
290 GET#8,L$:GET#8,H$:LN=ASC(L
    $+NULL$)+ASC(H$+NULL$)*256
    :RETURN               :rem 220
300 REM CHARACTER RETRIEVAL RO
    UTINE                 :rem 216
310 GET#8,B$:B=ASC(B$+NULL$):R
    ETURN                 :rem 76
320 REM QUOTE STRING RETRIEVAL
     ROUTINE              :rem 178
330 IF(B<32)OR((B<160)AND(B>12
    8))THENA$=A$+SC$+CHAR$(B)+
    EC$:GOTO350           :rem 237
340 A$=A$+B$              :rem 47
350 GOSUB310:IF(B=34)OR(B=0)TH
    ENRETURN              :rem 92
360 GOTO330               :rem 104
370 REM KEYWORD INTERPRETER
                          :rem 247
380 A$=A$+S$+KEYWRD$(B-128)+E$
                          :rem 88
390 IFB=167THENCOF=COF+2:GOTO4
    30                    :rem 203
400 IF8=129THENFOF=FOF+2:GOTO4
    30                    :rem 199
410 IF8=130THENFOF=FOF-2:NSP=N
    SP-2:GOTO430          :rem 122
420 IF8=143THENA$=A$+RS$
                          :rem 102
430 B$="":RETURN          :rem 152
440 REM LINE PRINT ROUTINE
                          :rem 87
450 PRINT#4,LS$SPC(NSP)A$+RE$:
    A$="":NSP=FOF+COF:RETURN
                          :rem 95
460 REM END ROUTINE       :rem 123
470 PRINT"FINISHED":CLOSE8:CLO
    SE4:END               :rem 19
480 REM SPECIAL CHARACTER DESC
    RIPTORS               :rem 96
490 DATA"NULL","1","2","3","4"
    ,"WHITE","6","7","SHFTC=OF
    F"                    :rem 126
500 DATA"SHFTC=ON","10","11","
    12","CR","LOWERCASE","15",
    "16","CRSR DOWN"      :rem 228
510 DATA"RVS ON","HOME","DELET
    E","21","22","23","24","25
    ","26","27"           :rem 34
520 DATA"RED","CRSR RIGHT","GR
    EEN","BLUE"           :rem 113
530 DATA"ORANGE","","","","F1"
    ,"F3","F5","F7","F2","F4",
    "F6","F8"             :rem 86
540 DATA"SHFT CR","UPPERCASE",
    "BLACK","","CRSR UP","RVS
    {SPACE}OFF","CLEAR","INSER
    T"                    :rem 199
550 DATA"BROWN","LIGHT RED","G
    RAY 1","GRAY 2","LIGHT GRE
    EN","LIGHT BLUE"      :rem 85
560 DATA"GRAY 3","PURPLE","CRS
    R LEFT","YELLOW","CYAN"
                          :rem 99
570 REM KEYWORDS          :rem 248
580 DATA"END","FOR ","NEXT ","
    DATA ","INPUT#"       :rem 5
590 DATA"INPUT ","DIM ","READ
    {SPACE}","LET ","GOTO "
                          :rem 224
600 DATA"RUN","IF ","RESTORE",
    "GOSUB ","RETURN"     :rem 60
610 DATA"REM","STOP","ON ","WA
    IT","LOAD "           :rem 81
620 DATA"SAVE ","VERIFY","DEF
    {SPACE}","POKE ","PRINT#",
    "PRINT ","CONT","LIST","CL
    R"                    :rem 6
630 DATA"CMD ","SYS ","OPEN ",
    "CLOSE ","GET ","NEW","TAB
    (","TO ","FN ","SPC("
                          :rem 240
640 DATA" THEN"," NOT "," STEP
    "," + "," - "," * "," / "
    ,"^"                  :rem 149
650 DATA" AND "," OR "," > ","
    = "," < ","SGN "      :rem 60
660 DATA"INT","ABS","USR","FRE
    ","POS","SQR","RND","LOG",
    "EXP","COS","SIN"     :rem 220
670 DATA"TAN","ATN","PEEK","LE
    N","STR$","VAL","ASC","CHR
    $","LEFT$","RIGHT$"
                          :rem 126
680 DATA"MID$","GO"       :rem 128
```

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Atari Cassette Verify

Dan Stromberg

This short, relocatable machine language routine verifies whether a tape save was successful on all Atari 400/800, XL, and XE computers.

Atari BASIC provides no command for verifying whether a CSAVE or LIST to cassette was successful. "Atari Cassette Verify" remedies that problem. Just type in the program below, save it for future use, and run it. Only a few moments are required to POKE the machine language (ML) routine into memory locations 1644–1746 (near the top of page 6). Since this routine is fully relocatable, you can change the address values in line 100 to whatever other location is convenient. This should be a location which is not erased when other BASIC programs are CLOADed.

Once Cassette Verify is in memory, it's available for use at any time. To verify a program that you've saved, simply type PRINT USR(1664) and press RETURN. (Of course, if you relocate the ML, you should change the 1664 to the new starting address.) You'll hear a buzzing sound, just like the one caused by typing a LOAD command. Position the tape at the file you want to verify, then press any key.

While the ML routine is verifying, you'll hear the usual beeping sounds through the speaker of your TV or monitor. When the operation is complete, the computer prints a number on the screen. If that number is one, the verify was successful—that is, the program on tape matches the program in memory. If you see any other number, consult your BASIC manual to see what the error number means before attempting to resave your program.

Atari Cassette Verify

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
NF 100 FOR INC=1664 TO 1746
IF 110 READ BYTE:POKE INC,BY
       TE
KM 120 NEXT INC
FA 130 DATA 104,162,48,169,3
       ,157,66,3,169,29,157,
       68,3,169,3,157,69,3,1
       69,1,157,72,3,169
OH 140 DATA 0,157,73,3,169,4
       ,157,74,3,169,128,157
       ,75,3,32,86,228,48,24
       ,169,7,157,66,3
CE 150 DATA 169,0,157,72,3,1
       57,73,3,32,86,228,16,
       238,192,136,208,2,160
       ,1,132,195,132,212,16
       9
HM 160 DATA 0,133,213,169,12
       ,157,66,3,76,86,228
```

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Apple Keyboard Customizer

Robert Buehler

With this program you can reconfigure your Apple keyboard and even save the changes on disk for future use. It works on any Apple II-series computer with DOS 3.3.

Are you frustrated with the Apple keyboard? Are you curious about why Apple arranged the keys in a particular manner? Do you yearn for a numeric keypad? If so, "Keyboard Customizer" may be for you. It lets you rearrange your keyboard any way you want.

For example, you could convert part of the regular keyboard into a numeric keypad—and even make a hexadecimal pad if you desire. This pad can be laid out using the keys of your choice. Do you keep missing the RETURN key and wish it were larger? No problem. Define three keys as RETURNs.

Besides such things as adding a numeric pad, Keyboard Customizer gives you the opportunity to eliminate pet annoyances. For instance, the colon (:) is commonly used when typing Applesoft BASIC programs. As the regular keyboard is set up, the semicolon and colon share the same key. To enter a colon, you must press SHIFT. With Customizer, the positions of these two characters could be reversed.

The question mark is another familiar character for Applesoft programmers as an abbreviation for PRINT. Using Keyboard Customizer, you could reposition the question mark to the semicolon key, making it more accessible. All of these and any other modifications that fit your fancy are at your fingertips with Keyboard Customizer.

Typing The Program

To prepare Keyboard Customizer, you must type it in with "Apple MLX," COMPUTE!'s machine language entry program found elsewhere in this issue. MLX catches most typing mistakes as they happen and helps assure that you'll finish with an error-free copy. Read the MLX instructions carefully before you begin. When you run MLX, it asks for the starting and ending addresses of the listing you're about to enter. For Keyboard Customizer, respond with these addresses:

Starting address: 8000
Ending address: 81A7

When you finish typing the listing, MLX prompts you to save a copy on disk.

Four Customizer Commands

To run Keyboard Customizer, type BRUN KEYBOARD (or whatever filename you specified when you saved the program with MLX). The READY message should appear as usual.

Keyboard Customizer has four commands, which must be preceded by an ampersand (&). Here's a brief summary:

&0 Restores the keyboard to its original configuration (as does RESET or a reboot).

&1 Activates the customized keyboard.

&2 Enters the keyboard editor.

&3 Prints a list of key values in the format *original key = customized key value*.

All these commands are pretty much self-explanatory except for &2, which calls up the keyboard editor. This is the tool for altering the key values. The first thing you notice after typing &2 is the message FIRST KEY:. This means the program is asking you to begin defining the range of keys you want to customize.

The editor looks at keys sequentially by their ASCII codes. ASCII (American Standard Code for Information Interchange) is a system which assigns numbers to standard characters which appear on teletype and computer keyboards. The ASCII code for an uppercase A, for example, is 65; B is 66; C is 67; and so on. All letters, numbers, punctuation marks, and other symbols have an ASCII code, and a table of these codes can be found in the *Apple II User's Guide* or just about any other computer manual. You can also determine the ASCII value of a character in BASIC by typing PRINT ASC("A"), substituting the appropriate character for A.

To specify a range of keys, first find the ASCII value of the *lowest-numbered* character you want to customize. Enter this value at the FIRST KEY: prompt. Then find the

ASCII value of the *highest-numbered* character you want to customize. Enter this value at the following prompt, which is LAST KEY:. (Therefore, the value you enter at the FIRST KEY: prompt should always be equal to or less than the value you enter at the LAST KEY: prompt.) Any character can begin or end the range, including ESCape or control characters. You'll notice that control characters along with ESCape are displayed in inverse video for easier identification.

After entering the range of keys you wish to edit, you'll see the message ENTER THE NEW REPLACEMENT VALUE FOR EACH KEY. The program displays the first character in the range you specified, followed by a colon. Next, enter the new replacement character. Do not press RETURN—Keyboard Customizer automatically enters a carriage return and then prompts you with the next key to be edited.

When you've assigned new values to all the keys in the range, the program returns to BASIC. Try typing one of the keys you have altered. It should return the reassigned character. Enter a command using that key, or write a program using the key. Even in PRINT and INPUT statements, the key yields its new character value.

How It Works

It seems as though Keyboard Customizer brings about some drastic changes. Actually, it doesn't. To understand how the program works, let's review how the Apple handles keyboard input.

Every time a key is pressed, Applesoft BASIC looks at memory locations $38–$39, its input hook. These locations normally contain the address of KEYIN ($FD1B), a routine in Read Only Memory (ROM) that gets the keypress from the keyboard. However, the input hook can be made to point to an alternate input routine. This is the case with Keyboard Customizer. Control passes not to the KEYIN routine in ROM, but rather to a routine within Customizer. This routine calls KEYIN to get the character code for the keypress, but checks to see if the code belongs to a character that was altered. If so, Customizer replaces it with the customized value.

The part of Customizer which replaces the old key values is actually very short (only five bytes). A much larger part of the program is the buffer it uses to store the modified values. Along with the editor, the buffer comprises the majority of the program. The buffer is so large because it stores the values for all the keys sequentially, even if they equal the original values. As a result, the buffer size is constant: half a page of memory (128 bytes). It may seem like a waste of memory to store the values of keys which haven't been changed. But if only modified keys were stored in the buffer, the routine that replaces the character values would be much longer and more complicated.

This brings up another important point. Keyboard Customizer's improvements are temporary, since the input hook at $38–$39 is initialized during a reset or reboot. But there's a way to save the keyboard changes you've made. First, enter the Apple's built-in machine language monitor by typing CALL−151. Then type this line and press RETURN:

```
8016: EA EA EA
```

This stops Keyboard Customizer from clearing the buffer by overwriting three machine language instructions with NOPs (No Operation, similar to REM in BASIC). Second, you'll need to save the buffer that holds all the modifications, along with the original program. Enter this command:

```
BSAVE KEYBOARD1,A$8000,L$23C
```

To run this new version, simply type BRUN KEYBOARD1. You could also include the command BRUN KEYBOARD1 in the HELLO program so the customized keyboard automatically loads every time you boot the system.

Keyboard Customizer Routines and Important Locations

AMPERV	$3F5	Holds JMP instruction to S/R for & commands
CH	$24	Cursor horizontal displacement
COUT	$FDF0	Prints byte in accumulator on screen
CRDO	$DAFB	Prints a carriage return
CV	$25	Cursor vertical position
DOSHOOK	$3EA	Connects I/O hooks to DOS
GETBYT	$E6F8	Evaluates formula at TXTPTR
KEYIN	$FD1B	Gets next key input from keyboard
KSWL	$38–$39	DOS input hook
RDKEY	$FD0C	Call KEYIN via KSWL

Please refer to the "MLX" article in this issue before entering the following listing.

Apple Keyboard Customizer

```
START ADDRESS:  8000
END ADDRESS:    81A1

8000: A2 4C A0 2F A9 80 8E F5 CE
8008: 03 8C F6 03 8D F7 03 A0 AF
8010: 4C A9 81 20 38 81 20 28 1F
8018: 81 20 6F F8 A0 27 A9 80 05
8020: 84 38 85 39 4C EA 03 20 E9
8028: 18 FD A8 89 21 81 60 20 D6
8030: F8 E6 E0 00 D0 0A A0 57 CA
8038: A9 81 20 38 81 4C 19 81 17
8040: E0 02 D0 69 20 19 81 A0 E8
8048: 86 A9 81 20 38 81 20 0C 55
8050: FD 8D 9E 81 20 23 81 20 50
8058: F0 FD A0 91 A9 81 20 38 4D
8060: 81 20 0C FD 8D A0 81 20 9D
8068: 23 81 20 F0 FD A0 5C A9 43
8070: 81 20 38 81 20 19 81 AD CF
8078: 9E 81 20 23 81 20 F0 FD C8
8080: A9 8A 20 F0 FD A9 A0 20 10
8088: F0 FD 20 0C FD 8D 9F 81 2D
8090: 20 23 81 20 F0 FD AC 9E 14
8098: 81 AD 9F 81 99 21 81 20 46
80A0: F8 DA CC A0 81 F0 60 EE 79
80A8: 9E 81 4C 77 80 E0 03 D0 B8
80B0: 48 20 58 FC 20 F8 DA AD 8E
80B8: 9F 81 85 24 AD 9E 81 20 E7
80C0: 23 81 20 F0 FD A9 8D 20 F8
80C8: F0 FD AE 9E 81 BD 21 81 48
80D0: 20 23 81 20 F0 FD EE 9E D8
80D8: 81 20 F8 DA AD 9E 81 C9 84
80E0: DF F0 24 A5 25 C9 14 D0 36
80E8: CE A9 00 85 25 A9 08 18 0C
80F0: 6D 9F 81 8D 9F 81 20 F8 D8
80F8: DA 4C 87 80 A0 54 A9 81 A4
8100: 20 38 81 4C 1C 80 60 A9 24
8108: 00 8D 9F 81 A9 80 8D 9E 83
8110: 81 A9 DE 8D A0 81 4C 1C 82
8118: 80 20 89 FE 20 93 FE 20 F1
8120: EA 03 60 C9 A0 10 03 38 85
8128: E9 80 60 A9 80 A2 00 9D 13
8130: A1 81 E8 A8 C8 98 C9 FF 48
8138: D0 F5 60 84 06 85 07 A0 6A
8140: 00 81 06 F0 06 20 F0 FD 10
8148: C8 D0 F6 60 8D D2 C5 C1 CD
8150: C4 D9 8D 00 CF CE 00 CF 67
8158: C6 C6 87 00 8D 8D C5 CE 5E
8160: D4 C5 D2 A0 D4 C8 C5 A0 99
8168: CE C5 D7 A0 D2 C5 D0 CC 65
8170: C1 C3 C5 CD C5 CE D4 8D 78
8178: C6 CF D2 A0 C5 C1 C3 C8 8C
8180: A0 C8 C5 D9 8D 00 C6 C9 E0
8188: D2 D3 D4 A0 C8 C5 D9 8A 72
8190: 00 A0 A0 A0 CC C1 D3 D4 C3
8198: A0 C8 C5 D9 8A 00 80 00 0C
81A0: DE 00 00 00 FF FF 00 00 13
```

IBM Advanced Function Key Techniques

Peter F. Nicholson, Jr.

Restoring original key definitions, extending definitions for certain keys beyond the default limits, and saving definitions to disk for later use are among the techniques covered in this revealing article. For the IBM PC and PCjr and most compatibles.

Anyone who has ever redefined the function keys in an IBM BASIC program probably has wondered why there's no command to restore the keys' original definitions when the program ends. Usually you end up disabling them or redefining them again to their default values. But there is an alternative, and the secret lies within something called the *soft key buffer*. Locating and examining this buffer can yield some interesting results.

Finding the buffer is easy if you have an IBM PC, XT, or PCjr. It starts at memory location 1619 in the default memory segment. But this is not necessarily true if you have an IBM-compatible computer. Therefore, if you're using a compatible, you should run Program 1. This program attempts to locate the soft key buffer for you. When you find it, you should alter the buffer address (1619) in the IBM programs before running them on your compatible. The lines where this address can be found are indicated in REMark statements within each program.

Saving Key Definitions

The soft key buffer is just a section of memory which stores the definitions for the function keys. When a key is assigned a different function, its definition within the buffer is altered. A key definition can contain up to 15 characters. If you PEEK into the buffer's memory locations, you may be surprised to find that each key is assigned not 15, but 16 positions. We'll explain why in a moment. In the meantime, knowing the number of positions allotted for each function key makes it easy to save the buffer's contents—and therefore to preserve the keys' definitions.

Program 2 does this by reading the contents of the buffer into an array. Then it assigns new functions to the keys (nonsense definitions for this example). Finally, the program lets you restore the original functions by POKEing the contents of the array back into the soft key buffer. You can use this technique in your own programs to restore the function keys.

Now, if you're still wondering why each key is assigned 16 positions in the buffer when its definition can be only 15 characters long, disabling the keys will provide the answer. If you PEEK at the 16 positions reserved for F1 (originally defined as LIST) and print out the ASCII values, this is what you'll see:

```
L I S T 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

When you disable F1, the buffer looks like this:

```
0 I S T 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
```

This seems to indicate that BASIC marks the end of a function key definition with a zero. To prove this, run Program 3. It demonstrates that you can restore the function keys after disabling them by merely saving the first character of each key definition (assuming, of course, that the keys have been disabled by overwriting only the first character of the definition). That's why Program 3 needs to save only 10 bytes instead of the 160 bytes saved by Program 2.

Extended Definitions

Knowing that you can restore the disabled function keys by saving only the first character of each definition may be interesting, but the difference between 10 and 160 bytes probably is of little concern to you. The real power in this knowledge is that you can extend the number of characters available for a function key's definition by altering the sixteenth position in the buffer for that key. This lets you assign a longer definition to a function key (at the expense of the following key, however).

For instance, I prefer to edit programs in SCREEN 0,0,0 and WIDTH 80. Using Program 4, I can set F9 to execute these commands even though they exceed 15 characters. F10 becomes useless, since we haven't increased the size of the soft key buffer—just the length of F9's definition within that buffer.

Program 4 also lets you save the new function key definitions as

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a file which can be BLOADed from another program. If you try this, don't omit the buffer address (1619) when BLOADing the file, since there is no way to insure that BASIC's segment will be the same as when you originally created the file.

For instructions on entering these listings, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

Program 1: Buffer Finder For Compatibles

```
PC 100 DEF SEG:SCREEN 0:WIDTH 80
       :X=0
OH 110 CLS:PRINT "MEMORY LOCATIO
       N ";:LOCATE ,20
IO 120 KEY 1,"LIST":A=ASC("L")
DG 130 IF PEEK(X)=A THEN GOSUB 1
       50 ELSE PRINT X;:LOCATE 1
       ,20
JG 140 X=X+1:GOTO 130
OM 150 IF CHR$(PEEK(X+1))<>"I" T
       HEN RETURN
PG 160 IF CHR$(PEEK(X+2))<>"S" T
       HEN RETURN
CG 170 IF CHR$(PEEK(X+3))<>"T" T
       HEN RETURN
JK 180 CLS:PRINT "MEMORY LOCATIO
       N ";X
NH 190 FOR J=1 TO 10:PRINT "F";J
       ;:FOR K=0 TO 15
AH 200 IF PEEK(X+16*(J-1)+K)>0 T
       HEN PRINT CHR$(PEEK(X+16*
       (J-1)+K)); ELSE 220
OO 210 NEXT K
PP 220 PRINT:NEXT J
GG 230 BEEP:INPUT "IS THIS IT ";
       Q$
ND 240 IF Q$="Y" OR Q$="y" THEN
       END ELSE X=X+1:CLS:GOTO 1
       10
```

Program 2: Restoring Function Definitions

```
HO 90 REM LINES WHICH USE 1619 O
      FFSET ARE 140 AND 250
DB 100 SCREEN 0:WIDTH 80:CLS:DEF
       SEG:OPTION BASE 1
QM 110 KEY ON:DIM K$(10):FOR X=1
       TO 10:K$(X)=STRING$(16,0
       ):NEXT X:' STORAGE AREA F
       OR FUNCTION KEYS
BG 120 REM SAVE FUNCTION KEYS
NL 130 FOR X=1 TO 10:FOR J=0 TO
       15
EH 140 MID$(K$(X),J+1,1)=CHR$(PE
       EK(1619+16*(X-1)+J))
OP 150 NEXT J,X
HA 160 REM REDEFINE FUNCTION KEY
       S WITH LETTERS (THIS IS O
       NLY AN EXAMPLE)
JC 170 FOR X=1 TO 10:KEY X,CHR$(
       X+64):NEXT X:KEY LIST
EO 180 PRINT "Function keys are
       redefined":PRINT "Press a
       ny key to restore"
NP 190 KB$=INKEY$:IF KB$="" THEN
        190
PF 200 REM RESTORE FUNCTION KEYS
OF 210 FOR X=1 TO 10
CC 220 KEY X,K$(X)
HM 230 NEXT X:CLS
PL 240 FOR X=1 TO 10
HE 250 J=ASC(MID$(K$(X),16,1)):I
       F J>0 THEN POKE 1619+16*(
       X-1)+15,J
MC 260 NEXT X:CLS
EL 270 KEY LIST
```

Program 3: Restoring Function Definitions

```
OL 90 REM LINES WHICH USE 1619 O
      FFSET ARE 140 AND 220
EK 100 SCREEN 0:WIDTH 80:CLS:DEF
       SEG
OG 110 KEY ON:K$=STRING$(10,0):'
        STORAGE AREA FOR FUNCTIO
       N KEYS
BG 120 REM SAVE FUNCTION KEYS
PI 130 FOR X=1 TO 10
QJ 140 MID$(K$,X,1)=CHR$(PEEK(16
       19+16*(X-1)))
GH 150 NEXT X
NJ 160 REM DISABLE FUNCTION KEYS
HE 170 FOR X=1 TO 10:KEY X,"":NE
       XT X:KEY LIST
MA 180 PRINT "Function keys are
       disabled":PRINT "Press an
       y key to restore"
NP 190 KB$=INKEY$:IF KB$="" THEN
        190
PF 200 REM RESTORE FUNCTION KEYS
OF 210 FOR X=1 TO 10
PO 220 POKE 1619+16*(X-1),ASC(MI
       D$(K$,X,1))
HN 230 NEXT X:CLS
DF 240 KEY LIST
```

Program 4: Extending Definitions

```
OC 90 REM LINES WHICH USE THE 16
      19 OFFSET ARE 180,290,390,
      440,470
IF 100 DEF SEG:STK$=STRING$(128,
       0):SCR$=STRING$(37,0):RES
       TORE 110:FOR X=1 TO 37:RE
       AD J:MID$(SCR$,X,1)=CHR$(
       J):NEXT X:SCR!=PEEK(VARPT
       R(SCR$)+1)+256*PEEK(VARPT
       R(SCR$)+2)
LG 110 DATA 85,137,229,139,118,6
       ,41,192,138,4,139,116,1
NB 120 DATA 1,240,137,196,184,0,
       6,187,0,7,185,0,2
FP 130 DATA 186,80,24,85,205,16,
       92,93,202,2,0
CE 140 SCREEN 0:WIDTH 80:CLS
HI 150 T$="Function Key Definiti
       on"
FN 160 LOCATE 2,(40-.5*LEN(T$)):
       PRINT T$
QP 170 PRINT:PRINT
NE 180 X=1:J=1:K=1619
EF 190 K$=STRING$(160,0):KN$=STR
       ING$(160,0):K=K-1
CP 200 L=PEEK(J+K)
PN 210 WHILE L<>0
PH 220 MID$(K$,J,1)=CHR$(L)
OK 230 J=J+1:L=PEEK(J+K)
EN 240 WEND
ID 250 PRINT "Function Key ";X;"
       : ";MID$(K$,1,J-1)
LI 260 PRINT:PRINT "Enter new de
       finition or press ENTER t
       o leave unchanged"
DB 270 LINE INPUT Q$:IF LEN(Q$)>
       0 THEN GOSUB 300:IF ER=1
       THEN ER=0:GOTO 250
LF 280 IF X+FIX(J/16)>9 THEN GOT
       O 380
JO 290 X=X+1+FIX(J/16):K=1619+16
       *(X-1)-1:J=1:CALL SCR!(ST
       K$):LOCATE 5,1:GOTO 200
QD 300 INPUT "Do you want a carr
       iage return (Y/N)";Q1$
BF 310 IF Q1$="Y" OR Q1$="y" THE
       N Q$=Q$+CHR$(13)
JJ 320 IF LEN(Q$)<16 THEN J=LEN(
       Q$):KEY X,Q$:RETURN
GK 330 M=1:N=16*(X-1)+1:IF N+LEN
       (Q$)>160 THEN BEEP:PRINT
       "Too long":ER=1:RETURN
PC 340 MID$(KN$,N,1)=MID$(Q$,M,1
       )
BF 350 M=M+1:N=1+N:IF M<=LEN(Q$)
       THEN 340
GN 360 IF LEN(Q$)>J THEN J=LEN(Q
       $)
NL 370 RETURN
PE 380 FOR X=1 TO 10
HP 390 IF ASC(MID$(KN$,16*(X-1)+
       1,1))>0 THEN FOR J=16*(X-
       1)+1 TO 16*X:POKE 1619+J-
       1,ASC(MID$(KN$,J,1)):NEXT
       J
FA 400 NEXT X:CLS:KEY LIST
JE 410 KB$=INKEY$:IF KB$="" THEN
        420 ELSE 410
IF 420 PRINT:INPUT "Do you want
       to save function keys as
       a BLOADable file (Y/N)";Q
       $
BJ 430 IF Q$="Y" OR Q$="y" THEN
       INPUT "Filename";F$ ELSE
       END
GN 440 BSAVE F$,1619,159:PRINT
EN 450 PRINT "To load your funct
       ion key file, use these c
       ommands:"
AA 460 PRINT:PRINT
NF 470 PRINT "DEF SEG:BLOAD ";CH
       R$(34);F$;CHR$(34);",1619
       :CLS":END
```

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Commodore 64 *SpeedScript* Fontmaker

Charles Brannon, Program Editor

Special fonts add character to any screen display. This article shows how to use custom character sets with any version 3.0 or higher of Commodore 64 SpeedScript. *This month's premiere edition of the Commodore* COMPUTE! DISK *includes the Fontmaker programs and sample font listed here, plus version 3.2 of* SpeedScript.

Writing with a word processor often means staring for hours at a video screen. For word processing, screen clarity is especially vital. It's best to have a good-quality color or monochrome monitor, but a clear, readable character set helps, too. Commodore's built-in character set works well and is especially designed for the low resolution of the average TV. However, it can be improved. Besides, it's just plain fun to use your own custom character set. A custom font personalizes your computer and sets it apart from the crowd. There are many font editor programs to design character sets for use with BASIC, but until now there was no way to use them with *SpeedScript*.

Type in Program 1, "Fontmaker Boot," and save it to disk—preferably as the very first program on the directory (this lets you conveniently LOAD "*",8 to start the process). Program 1 configures memory for Program 2, "Fontmaker," which does the actual work. Fontmaker won't do its job unless you've run Program 1 first. *You must save Program 2 with the name FONTMAKER, since this is the name Program 1 looks for when it runs.* To use another name, change line 20 of Program 1.

Fontmaker only installs a character set that has been previously created; it has no provisions for creating the custom characters. You can easily define your own fonts or edit the supplied ones with a character editor such as "Ultrafont" (*COMPUTE!'s First Book of Commodore 64 Sound and Graphics*). This article includes one sample character set that you can type in. Also, this month's premiere of the COMPUTE! DISK includes *SpeedScript 3.2*, Fontmaker Boot, Fontmaker, and the sample font listed below.

When you run Fontmaker, it prompts you for the name of the character set you'd like to use. By default, the cursor blinks on the filename SPEED.SET. If you'd like to use a font with that name, just press RETURN. Otherwise, type in a new name, overwriting SPEED.SET. If you want to run *SpeedScript* without a custom set, just type X at the prompt (you don't need to erase SPEED.SET; just enter an X).

The character set you've previously created with a font editor program must be on the same disk as the *SpeedScript* program. Fontmaker looks for *SpeedScript* under the filename SS. Either insert a different filename in line 140 of Program 2 or rename your copy of *SpeedScript* to SS. Fontmaker loads in *SpeedScript*, bumps up the start of text space (reducing available memory by about 11K), loads the character set into that gap, switches the screen to the new character set, then runs *SpeedScript*.

It's Only Temporary

Fontmaker does not permanently change *SpeedScript* unless you resave the word processor at this point (not recommended). In other words, Fontmaker installs the custom character set only for the current session. If you exit *SpeedScript* by pressing the RESTORE key, type POKE 53272,26 to restore the set before you type RUN to reenter *SpeedScript*.

When designing your custom character set, remember that vertical lines appear thinner and fuzzier than horizontal lines. Notice that every vertical line is doubled on the normal Commodore character set, making characters appear bold. You'll probably want to follow the same rule when designing your own sets. This is not a problem with crisp monochrome monitors. You can use the full 8 × 8 resolution of the character grid to design clean, well-formed characters.

Another guideline for readability is that uppercase characters are of uniform height. All lowercase characters are the same height, except for tall characters such as b, d, f, h, i, k, l, and t, which are the same height as uppercase letters. Normally you'll keep the rightmost column and the lowest row blank to keep characters from running into each other and to reserve room for

the lowercase descenders on the g, j, p, q, and y. Naturally, an exception is when you design cursive or script characters that should link together.

You'll also want to customize the punctuation marks and symbols. *SpeedScript* uses the back-arrow symbol as the carriage-return mark. If you don't like to see return-marks, just blank out that character. You can put a tiny dot in the SHIFT-SPACE character to distinguish it from a real space. It can also be convenient to define some of the graphics characters to their printing equivalent on the printer. For example, some graphics characters print as italic or foreign-language characters. Just edit the graphics characters to look like their printing equivalents.

You can also create your own custom cursor. *SpeedScript*'s cursor just alternates between the normal and reverse-video version of whatever character it's sitting on. The last 128 characters of a character set are the reverse-video ones. If you want an underline cursor, just copy the normal set down to the reverse-video area and draw a line through the bottom row of every character. Special characters can even have a unique cursor.

A Free Sample

The final listing below is a sample character set for you to type in. To do this, you must use our machine language entry program "MLX." Be sure you read and understand the instructions for using MLX before you begin entering the data. (In case you missed its introduction last month, COMPUTE! now has an enhanced version of MLX. See the article for details.) Unlike most listings you enter with MLX, *this listing is not a machine language program*—it's pure character definition data. However, that fact doesn't matter to MLX, nor does it affect the way MLX operates. MLX still asks you for starting and ending addresses. For the character data, here are the proper values:

Starting address: 7000
Ending address: 77FF

When you finish entering the character set data, be sure to save a copy on the same disk with Fontmaker, Fontmaker Boot, and *SpeedScript*. If you wish this to be the default character set for the Fontmaker program, save the character data with the filename SPEED.SET. This is the default name used in Program 2 (line 170).

For instructions on entering these listings, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

Program 1: Fontmaker Boot

```
10 PRINT"{CLR}{3 DOWN}POKE44,4
   8:POKE12288,0:NEW"   :rem 21
20 PRINT"{2 DOWN}LOAD"CHR$(34)
   "FONTMAKER"CHR$(34)",8"
                        :rem 122
30 PRINT"{4 DOWN}RUN{HOME}":PO
   KE198,3:POKE631,13:POKE632,
   13:POKE633,13:END   :rem 183
```

Program 2: Fontmaker

```
100 REM DO NOT RUN THIS PROGRA
    M UNTIL YOU SAVE IT
                        :rem 147
110 POKE53280,6:POKE53281,14:S
    P$="{RVS}{40 @}"    :rem 86
120 PRINT"{CLR}{N}{4 DOWN}
    {YEL}"SP$"{RED}"SP$"{PUR}"
    SP$"{CYN}"SP$:PRINTTAB(8)"
    {WHT}{2 DOWN}LOADING SPEED
    SCRIPT..."          :rem 6
130 PRINT"{5 DOWN}{CYN}"SP$"
    {PUR}"SP$"{RED}"SP$"{YEL}"
    SP$                 :rem 151
140 F$="SS":ADR=2049:GOSUB210
                        :rem 144
150 F$="":PRINT"{BLK}{11 UP}WH
    ICH CHARACTER SET WOULD YO
    U LIKE?"            :rem 175
160 PRINT"{ENTER X FOR ROM SET
    )"                  :rem 80
170 PRINT"{23}? SPEED.SET
    {11 LEFT}";:INPUT F$:IFLEF
    T$(F$,1)="X"THEN190
                        :rem 200
180 ADR=10240:GOSUB210:POKE532
    72,26:POKE 2473,48:rem 194
190 POKE44,8:SYS2061    :rem 151
200 END                 :rem 105
210 OPEN1,8,0,F$        :rem 76
220 POKE780,1:POKE781,8:POKE78
    2,0:SYS65466        :rem 214
230 POKE780,0:POKE782,ADR/256:
    POKE781,ADR-PEEK(782)*256:
    SYS65493            :rem 243
240 CLOSE1:RETURN       :rem 87
```

Sample Character Set

The character set data must be entered with the MLX machine language entry program elsewhere in this issue. Refer to the the MLX article before entering this listing.

```
7000:7C C6 DE DE C0 C0 78 00 94
7008:00 00 78 0C 7C CC 76 00 BC
7010:E0 60 60 7C 66 66 FC 00 14
7018:00 00 3C 66 60 66 3C 00 FB
7020:0E 06 06 3E 66 66 3F 00 79
7028:00 00 3C 66 7E 60 3E 00 E8
7030:1C 36 30 78 30 30 78 00 6D
7038:00 00 76 CC CC 7C 0C F8 1E
7040:E0 60 6C 76 66 66 E6 00 39
7048:18 00 38 18 18 18 3C 00 57
7050:0C 00 0C 0C 0C CC CC 78 1F
7058:E0 60 66 6C 78 6C E6 00 98
7060:70 30 30 30 30 30 78 00 C1
7068:00 00 CC FE D6 C6 C6 00 32
7070:00 00 7C 66 66 66 66 00 E0
7078:00 00 3C 66 66 66 3C 00 8C
7080:00 00 DC 66 66 7C 60 F0 3A
7088:00 00 76 CC CC 7C 0C 1E 93
7090:00 00 DC 76 60 60 F0 00 DA
7098:00 00 7C C0 7C 06 FC 00 0B
70A0:10 30 7C 30 30 36 1C 00 BA
70A8:00 00 CC CC CC CC 7E 00 86
70B0:00 00 66 66 66 3C 18 00 19
70B8:00 00 C6 D6 FE FE 6C 00 AC
70C0:00 00 C6 6C 38 6C C6 00 42
70C8:00 00 66 66 66 3E 06 7C 91
70D0:00 00 7E 4C 18 32 7E 00 CC
70D8:7C 60 60 60 60 60 7C 00 9F
70E0:0C 12 30 7C 30 62 FC 00 1F
70E8:3E 06 06 06 06 06 3E 00 50
70F0:00 10 38 7C 10 10 10 00 85
70F8:00 00 0C 8C 58 60 70 00 41
7100:00 00 00 00 00 00 00 00 E2
7108:18 3C 3C 18 18 00 18 00 FF
7110:66 66 66 24 00 00 00 00 CE
7118:6C 6C FE 6C FE 6C 6C 00 75
7120:18 3E 60 3C 06 7C 18 00 C0
7128:00 C6 CC 18 30 66 C6 00 80
7130:38 6C 38 76 CC CC 76 00 3F
7138:0C 0C 18 00 00 00 00 00 27
7140:0C 18 30 30 30 18 0C 00 32
7148:30 18 0C 0C 0C 18 30 00 AC
7150:00 66 3C FF 3C 66 00 00 CF
7158:00 18 18 7E 18 18 00 00 4D
7160:00 00 00 00 00 18 18 30 04
7168:00 00 00 7E 00 00 00 00 33
7170:00 00 00 00 00 18 18 00 E3
7178:00 06 0C 18 30 60 C0 00 64
7180:7C C6 CE DE F6 C6 7C 00 E6
7188:18 38 18 18 18 18 7E 00 28
7190:3C 66 06 1C 30 66 7E 00 C5
7198:3C 66 06 1C 06 66 3C 00 F7
71A0:1C 3C 6C CC FE 0C 0C 00 3B
71A8:7E 60 7C 06 06 66 3C 00 15
71B0:1C 30 60 7C 66 66 3C 00 C6
71B8:7E 66 06 0C 18 18 18 00 47
71C0:3C 66 66 3C 66 66 3C 00 31
71C8:3C 66 66 3E 06 0C 38 00 E4
71D0:00 18 18 00 18 18 00 00 DD
71D8:00 18 18 00 00 18 18 30 85
71E0:0E 18 30 60 30 18 0E 00 DA
71E8:00 00 7E 00 7E 00 00 00 8F
71F0:70 18 0C 06 0C 18 70 00 95
71F8:3C 66 06 0C 18 00 18 00 06
7200:30 30 18 00 00 00 00 00 0C
7208:18 3C 66 66 7E 66 66 00 95
7210:FC 66 66 7C 66 66 FC 00 68
7218:3C 66 C0 C0 C0 66 3C 00 F0
7220:F8 6C 66 66 66 6C F8 00 A6
7228:FE 62 68 78 68 62 FE 00 84
7230:FE 62 68 78 68 60 F0 00 68
7238:3C 66 C0 C0 CE 66 3E 00 85
7240:C6 C6 C6 FE C6 C6 C6 00 E1
7248:3C 18 1B 1B 18 1B 3C 00 6F
7250:1E 0C 0C 0C CC CC 78 00 14
7258:E6 66 6C 78 6C 66 E6 00 2A
7260:F0 60 60 60 62 66 FE 00 92
7268:C6 EE FE FE D6 C6 C6 00 9B
7270:C6 E6 F6 DE CE C6 C6 00 5E
7278:3B 6C C6 C6 C6 6C 38 00 32
7280:FC 66 66 7C 60 60 F0 00 78
7288:78 CC CC CC DC 78 1C 00 44
7290:FC 66 66 7C 6C 66 F6 00 0D
7298:3C 66 70 38 0E 66 3C 00 49
72A0:7E 5A 18 18 18 18 3C 00 79
72A8:C6 C6 C6 C6 C6 C6 7C 00 32
72B0:C6 C6 C6 C6 C6 7C 38 00 88
72B8:C6 C6 C6 D6 FE EE C6 00 3A
72C0:C6 C6 6C 38 38 6C C6 00 CC
72C8:66 66 66 3C 18 18 3C 00 A4
72D0:FE C6 8C 18 32 66 FE 00 23
```

```
72D8:1C 30 30 60 30 30 1C 00 5E
72E0:18 18 18 00 18 18 18 00 2C
72E8:38 0C 0C 06 0C 0C 38 00 CF
72F0:00 00 03 3E 76 36 36 00 13
72F8:00 6C 8A 8C 8A 8A 6C 00 6A
7300:00 00 00 10 00 00 00 00 E7
7308:F0 F0 F0 F0 F0 F0 F0 F0 EE
7310:00 00 00 00 FF FF FF FF F6
7318:FF 00 00 00 00 00 00 00 FE
7320:00 00 00 00 00 00 00 1F 26
7328:C0 C0 C0 C0 C0 C0 C0 C0 0F
7330:CC CC 33 33 CC CC 33 33 7D
7338:03 03 03 03 03 03 03 03 1F
7340:00 00 00 00 CC CC 33 33 5A
7348:FF FE FC F8 F0 E0 C0 80 2B
7350:03 03 03 03 03 03 03 03 37
7358:18 18 18 1F 1F 18 18 18 E7
7360:00 00 00 00 0F 0F 0F 0F 29
7368:18 18 18 1F 1F 00 00 00 4F
7370:00 00 00 F8 F8 18 18 18 57
7378:00 00 00 00 00 00 FF FF 5F
7380:00 00 00 1F 1F 18 18 18 FA
7388:18 18 18 FF FF 00 00 00 B4
7390:00 00 00 FF FF 18 18 18 20
7398:18 18 18 F8 F8 18 18 18 94
73A0:C0 C0 C0 C0 C0 C0 C0 C0 87
73A8:E0 E0 E0 E0 E0 E0 E0 E0 8F
73B0:07 07 07 07 07 07 07 07 97
73B8:FF FF 00 00 00 00 00 00 9F
73C0:FF FF FF 00 00 00 00 00 A7
73C8:00 00 00 00 00 FF FF FF AF
73D0:03 03 03 03 03 03 FF FF AE
73D8:00 00 00 00 F0 F0 F0 F0 DD
73E0:0F 0F 0F 0F 00 00 00 00 E5
73E8:18 18 18 F8 F8 00 00 00 3C
73F0:F0 F0 F0 F0 00 00 00 00 B9
73F8:F0 F0 F0 F0 0F 0F 0F 0F A3
7400:82 39 21 21 3E 38 84 78 03
7408:00 7C 86 72 82 32 89 36 2E
7410:D0 50 5C 42 59 D9 82 FC 59
7418:00 3C 42 99 96 99 42 3C CD
7420:11 09 39 41 99 99 41 1E E2
7428:00 3C 42 99 81 9E 41 3E 49
7430:22 49 4E 84 48 48 84 3C 37
7438:00 76 89 32 32 02 F2 04 96
7440:10 90 92 89 99 99 19 66 0C
7448:24 18 44 24 24 24 42 7E C8
7450:12 0C 12 12 D2 92 B2 44 33
7458:10 97 99 92 84 92 19 E6 13
7460:78 88 48 48 48 48 84 78 1A
7468:00 CC 33 01 29 39 29 C6 42
7470:00 7C 82 99 99 99 99 66 2F
7478:00 3C 42 99 99 99 42 3C 46
7480:00 DC 22 99 99 82 98 04 8A
7488:00 77 89 32 32 82 32 21 C4
7490:00 DC 22 89 96 90 08 F0 85
7498:00 7C 82 3C 82 79 02 FC AF
74A0:28 4C 82 4C 4C 40 22 1C 89
74A8:00 CE 32 32 32 32 81 7E 8A
74B0:00 66 99 99 99 42 24 18 36
74B8:00 C7 29 28 00 00 93 6E D0
74C0:00 C7 29 92 44 92 29 C7 70
74C8:00 66 99 99 99 41 79 82 5F
74D0:00 7E 81 B2 24 49 81 7E 7C
74D8:82 9E 90 90 90 9E 82 FE C8
74E0:12 2D 4C 82 4C 99 82 7C 1A
74E8:41 79 09 09 09 79 41 FF 33
74F0:10 28 44 B2 EE 28 28 38 3D
74F8:00 1E 1E DE FE F8 F0 F8 D1
7500:00 00 3C 24 24 24 3C 00 DE
7508:24 42 42 24 24 18 24 18 02
7510:99 99 99 DB 24 00 00 00 40
7518:92 92 01 92 01 92 92 6E 20
7520:24 42 9C 42 39 82 64 1C 1E
7528:C6 39 F2 24 4E 99 29 C6 57
7530:44 52 46 89 32 32 89 76 17
7538:1E 12 32 24 18 00 00 00 FF
7540:12 24 48 48 48 64 32 0E 11
7548:48 24 12 12 12 26 4C 70 F5
7550:66 18 C3 00 C3 1B 66 00 3B
7558:3C 24 E7 81 E7 24 3C 00 C7
7560:00 00 00 3C 24 24 24 48 51
7568:00 00 7E 81 7E 00 00 00 2F
7570:00 00 00 00 18 24 24 18 0D
7578:06 09 12 24 48 90 20 40 32
7580:82 39 31 21 09 39 82 7C E1
7588:24 44 24 24 24 66 81 7E 99
7590:42 99 79 22 4C 99 81 7E 9E
7598:42 99 79 22 39 99 82 7C 0E
75A0:22 42 92 32 01 F2 12 1E B8
75A8:81 9E 82 79 F9 99 42 3C DA
75B0:22 4C 9C 82 99 99 42 3C 6F
75B8:81 99 79 32 24 24 24 3C 53
75C0:42 99 99 42 99 99 42 3C 7E
75C8:42 99 99 41 39 32 44 78 16
75D0:3C 24 3C 00 3C 24 3C 00 55
75D8:3C 24 3C 00 3C 24 24 78 A5
75E0:11 26 4C 98 4C 26 11 0F 1D
75E8:00 7E 81 7E 81 7E 00 00 91
75F0:88 64 32 19 32 64 88 F0 36
75F8:42 99 59 12 24 18 24 18 99
7600:78 48 4C 24 18 00 00 00 C7
7608:24 42 99 99 81 99 99 66 70
7610:02 99 99 82 99 99 02 FC F3
7618:42 99 26 20 26 99 42 3C AB
7620:04 92 99 99 99 92 04 F8 98
7628:01 9D 96 84 96 9D 01 FE 44
7630:01 9D 96 84 94 98 08 F0 28
7638:41 99 3E 3E 31 99 41 3E 88
7640:66 99 99 81 99 99 99 66 DE
7648:42 24 24 24 24 24 42 3C 98
7650:21 12 12 92 12 32 84 78 98
7658:1F 91 92 84 92 99 19 E6 E7
7660:08 90 90 92 95 99 01 FE C4
7668:29 11 01 01 29 39 29 C6 A5
7670:24 14 0D 21 31 29 29 C6 6F
7678:44 92 39 39 39 92 44 38 BB
7680:02 99 99 82 9C 90 08 F0 58
7688:04 32 32 32 22 84 62 1C 71
7690:02 99 99 82 92 99 09 F6 44
7698:42 99 8E 46 71 99 C2 7C 37
76A0:81 A5 66 24 24 26 42 3C 41
76A8:29 29 29 29 29 39 82 7C DB
76B0:29 29 29 29 39 82 44 38 C8
76B8:29 29 39 28 00 11 29 C6 8B
76C0:29 29 92 44 44 92 29 C7 A9
76C8:99 99 99 42 24 24 42 3C B2
76D0:01 F9 12 24 4C 9F 01 FE 23
76D8:22 4C C8 90 C8 4C 22 1E E5
76E0:3C 24 24 3C 3C 24 24 3C 34
76E8:44 32 13 09 13 32 44 78 D9
76F0:00 03 3C C1 89 C9 49 36 7E
76F8:FF 93 75 73 75 75 93 FF 59
7700:FF FF FF EF FF FF FF FF ED
7708:0F 0F 0F 0F 0F 0F 0F 0F F6
7710:FF FF FF FF 00 00 00 00 FE
7718:00 FF FF FF FF FF FF FF 07
7720:FF FF FF FF FF FF 00 0F
7728:3F 3F 3F 3F 3F 3F 3F 3F 17
7730:33 33 CC CC 33 33 CC CC B8
7738:FC FC FC FC FC FC FC FC 27
7740:FF FF FF FF 33 33 CC CC FB
7748:00 01 03 07 0F 1F 3F 7F 3B
7750:FC FC FC FC FC FC FC FC 3F
7758:E7 E7 E7 E0 E0 E7 E7 E7 9E
7760:FF FF FF FF F0 F0 F0 F0 6D
7768:E7 E7 E7 E0 E0 FF FF FF 57
7770:FF FF FF 07 07 E7 E7 E7 5F
7778:FF FF FF FF FF FF 00 00 67
7780:FF FF FF E0 E0 E7 E7 E7 DB
7788:E7 E7 E7 00 00 FF FF FF 62
7790:FF FF FF 00 00 E7 E7 E7 D6
7798:E7 E7 E7 07 07 E7 E7 E7 72
77A0:3F 3F 3F 3F 3F 3F 3F 3F 8F
77A8:1F 1F 1F 1F 1F 1F 1F 1F 97
77B0:F8 F8 F8 F8 F8 F8 F8 F8 9F
77B8:00 00 FF FF FF FF FF FF A7
77C0:00 00 00 FF FF FF FF FF AF
77C8:FF FF FF FF FF 00 00 00 B7
77D0:FC FC FC FC FC FC 00 00 C8
77D8:FF FF FF FF 0F 0F 0F 0F A9
77E0:F0 F0 F0 F0 FF FF FF FF B1
77E8:E7 E7 E7 07 07 FF FF FF 6B
77F0:0F 0F 0F 0F FF FF FF FF FD
77F8:0F 0F 0F 0F F0 F0 F0 00 33
                                ©
```

Atari RESET Controller

Torben Pedersen

Here is a short machine language routine that traps the Atari SYSTEM RESET button in any BASIC program. An example program shows how disks can be protected with a password system that ignores BREAK and RESET. The routine works on any 400/800, XL, or XE with a disk drive.

A well-designed program should accept any input without crashing. This can be done to some extent by screening input and disabling the BREAK key. However, if a person happens to hit the Atari SYSTEM RESET button, the program abruptly halts. The solution to this problem is to disable RESET. Unfortunately, although BREAK can be turned off with only a couple of POKEs, the RESET button cannot be disabled. It can, however, be trapped—meaning that you can divert it from resetting the system to doing something else. But this job requires a machine language (ML) routine.

"Atari RESET Controller" lets you trap RESET in any BASIC program even if you don't know anything about machine language. Here are the steps to follow:

1. Type in and save Programs 1, 2, and 3.

2. Load and run Program 1. It prints six program lines—one of which

contains strange graphics characters—on the screen. The odd-looking string (ML$) actually contains the encoded ML routine. The lines are numbered from 60–110 so they'll fit into Program 2.

3. Without disturbing lines 60–110 on the screen, type NEW and press RETURN, then move the cursor over line 60 and press RETURN six times, entering lines 60–110 into memory.

4. LIST the lines to disk by typing LIST"D:TEMP" and pressing RETURN. This stores the lines in ASCII form so they can be merged later with Program 2.

5. Load Program 2 into memory, then type ENTER"D:TEMP" and press RETURN. This merges lines 60–110 back into memory without disturbing the rest of Program 2.

6. Resave Program 2 by typing SAVE"D:LOGON" and pressing RETURN. The program is saved to disk under the filename LOGON, and you have saved yourself the trouble of trying to type in the odd-looking string that contains the ML routine. Don't run Program 2 yet.

7. Load Program 3, insert the disk that contains the LOGON file, then run the program. Program 3 creates an AUTORUN.SYS file that automatically loads and runs LOGON whenever you boot the disk.

What's The Password?

Now that the package is complete, reboot the system by turning the computer off and on. The AUTORUN.SYS file loads and runs the LOGON program without any further action on your part.

When LOGON begins, it disables BREAK, traps RESET, and asks for a password. Until you type the right password, there's no way to break out of the program or proceed any further. In this case we know the password is SECRET (see line 300 of Program 2). Once it identifies you as an authorized user, LOGON restores BREAK and RESET, permitting the computer to work normally again. At this point, it's very important to reset the system by pressing RESET. If you omit this step, you won't be able to use the disk drive.

To use LOGON for your own programs, replace SECRET in line 300 with a password of your own. After that's done, the disk is effectively protected from use by anyone who doesn't know your password. Of course, somebody can circumvent this security system by booting from another disk, but this method should be sufficient for many purposes.

You might also want to trap RESET in a program intended for young children, or in any situation where a reset would cause problems. The ML routine created by Program 1 is actually quite simple. It diverts the computer from its normal reset routine to the custom routine stored in ML$. When you press RESET, the custom routine changes the character color from white to blue (to conceal printing), then prints RUN followed by a carriage return. As a result, pressing RESET reruns the program in memory.

For instructions on entering these listings, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

Program 1: Atari RESET Controller

```
BD 10 REM *** PROGRAM TO CRE
      ATE THE
CD 20 REM *** MACHINE LANGUA
      GE ROUTINE
GH 30 REM *** IN STRING FORM
EI 40 REM
LI 50 DIM ML$(65)
PA 60 PRINT "60 DIM ML$(65)"
MI 70 PRINT "70 ML$=";CHR$(3
      4);
BE 80 FOR I=1 TO 65
MG 90 READ A
CM 100 PRINT CHR$(A);
BK 110 NEXT I
NJ 120 PRINT CHR$(34)
AK 130 PRINT "80 ADDR=ADR(ML
      $)"
EP 140 PRINT "90 HIGH=INT(AD
      DR/256)"
FG 150 PRINT "100 LOW=ADDR-H
      IGH*256"
MD 160 PRINT "110 POKE 12,LO
      W:POKE 13,HIGH"
BJ 170 DATA 169,46,72,169,53
      ,72,169,50,72,169,148
      ,141,197,2,169,0,141,
      68,2,169,1,133,9
EA 180 DATA 173,48,2,133,203
      ,173,49,2,133,204,160
      ,4,177,203,133,205
OA 190 DATA 200,177,203,133,
      206,162,0,160,82,104,
      145,205,232
HP 200 DATA 200,224,3,208,24
      7,169,12,141,252,2,10
      8,250,191
```

Program 2: Logon

```
LP 150 DIM PASSWORD$(25)
MO 160 OPEN #1,4,0,"K:"
KC 200 GRAPHICS 0:SETCOLOR 2
      ,0,0
JK 210 POSITION 2,5:PRINT "L
      OGON:";
AK 220 POKE 16,64:POKE 53774
      ,64:REM DISABLE THE B
      REAK KEY
BG 260 GET #1,CHAR
CG 270 IF CHAR=155 OR LEN(PA
      SSWORD$)>25 THEN GOTO
       300
FC 280 PASSWORD$(LEN(PASSWOR
      D$)+1)=CHR$(CHAR)
GM 290 GOTO 260
PP 300 IF PASSWORD$="SECRET"
       THEN GOTO 340
KM 310 PASSWORD$=""
GH 320 GOTO 180
JB 360 POKE 12,64:POKE 13,21
      :REM RESET VECTOR
EG 370 POKE 16,192:POKE 5377
      4,192:REM ENABLE BREA
      K KEY
BM 380 GRAPHICS 0
HD 390 END
```

Program 3: AUTORUN.SYS Maker

```
MB 10 REM *** PROGRAM TO CRE
      ATE AN
OC 20 REM *** AUTORUN.SYS FI
      LE TO
MK 30 REM *** EXECUTE LOGON
      ON BOOT UP
EI 40 REM
PF 50 OPEN #2,8,0,"D:AUTORUN
      .SYS"
MK 60 PUT #2,255:PUT #2,255
PL 70 PUT #2,0:PUT #2,6
DL 80 PUT #2,69:PUT #2,6
BB 90 FOR I=1 TO 70
OD 100 READ A:PUT #2,A
BK 110 NEXT I
IN 120 PUT #2,226:PUT #2,2
IP 130 PUT #2,227:PUT #2,2
CJ 140 PUT #2,0:PUT #2,6
GB 150 CLOSE #2
DK 160 DATA 169,148,141,197,
      2,169,0,141,68,2,169,
      1,133,9
DP 170 DATA 173,48,2,133,203
      ,173,49,2,133,204,160
      ,4,177,203,133,205
OH 180 DATA 200,177,203,133,
      206,162,0,160,82,189,
      58,6,145,205,232
LF 190 DATA 200,224,12,208,2
      45,169,12,141,252,2,1
      08,250,191
BA 200 DATA 50,53,46,2,36,26
      ,44,47,39,47,46,2
```

Moving Marquee For Commodore 64

David W. Martin

Have you ever seen commercial software that scrolls a message across the screen? Here is a short routine you can add to any BASIC program to achieve the same effect.

How many times have you stared at the message PRESS ANY KEY TO CONTINUE? After using your computer for a while, you may become a bit tired of the same old screen displays. "Moving Marquee" lets you scroll any text message sideways across the top of the screen. Type in the program and save a copy, then run it to see how the marquee works.

Line 10 calls a subroutine at line 30000 which puts a machine language routine in memory. This needs to be done only once, when your program is performing setup tasks. Line 20 clears the top line of the screen and sets the corresponding area of color memory to white. Of course, you can use whatever color you like: To change the character color to red, change the 1 in line 20 to 2, and so on.

Line 30 lets you input the message of your choice. You may create the string any way that you like (for instance, A$="MESSAGE"), and the name of the string variable is not critical. However, you must add CHR$(0) to the end of the string (line 40) so the marquee routine knows where the message ends. In addition, since the routine always displays the last-defined string, you must not define any other strings before calling the routine with SYS.

Once you call the routine, it scrolls the entire string across the screen from right to left. Since this is done as a background task during the computer's hardware interrupt, the marquee display does not slow down the rest of your BASIC program. You may change the scrolling speed by POKEing a value from 0 to 128 into location 866 (the normal value is 5).

Moving Marquee

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
10 GOSUB30000:PRINTCHR$(147)CH
   R$(17)                 :rem 67
20 FORJ=39TO0STEP-1:POKE1024+J
   ,32:POKE55296+J,1:NEXT
                          :rem 158
30 INPUT"ENTER MESSAGE";A$
                          :rem 90
40 A$=A$+CHR$(0)          :rem 24
50 POKE1009,PEEK(PEEK(71)+PEEK
   (72)*256+2)            :rem 12
60 POKE1011,PEEK(PEEK(71)+PEEK
   (72)*256+1)             :rem 5
70 SYS1008:END            :rem 64
30000 FOR ADR=864 TO 1015:READ
      BYT:POKE ADR,BYT:NEXT:R
      ETURN               :rem 45
30010 DATA 40,0,5,49,234,15,5,
      40,160,1,185,0,4,153,255
      ,3,200,204,96,3     :rem 28
30020 DATA 208,244,32,161,3,20
      5,97,3,240,15,192,255,24
      0,11,200,140,101    :rem 82
30030 DATA 3,172,96,3,153,255,
      3,96,172,96,3,169,32,153
      ,255,3,238,103,3:rem 123
30040 DATA 173,103,3,205,96,3,
      176,48,96,172,101,3,177,
      251,41,191,96       :rem 234
30050 DATA 141,251,0,142,252,0
      ,169,0,141,103,3,141,101
      ,3,173,20,3,141     :rem 10
30060 DATA 99,3,173,21,3,141,1
      00,3,120,169,223,141,20,
      3,169,3,141,21,3    :rem 79
30070 DATA 88,96,120,173,99,3,
      141,20,3,173,100,3,141,2
      1,3,88,96,206       :rem 223
30080 DATA 102,3,16,9,32,104,3
      ,173,98,3,141,102,3,108,
      99,3,162,151,169:rem 105
30090 DATA 205,32,169,3,96,0,3
      2,32,32,32,0        :rem 0
```

Line Deleter For Atari

Bryce Wray

Here's a short, simple programming utility that quickly deletes any range of lines within an Atari BASIC program. It works on all 400/800, XL, and XE computers.

If you do much BASIC programming, you've undoubtedly needed "Line Deleter" at one time or another. There are only two other ways to delete a range of lines in Atari BASIC: the slow, manual method of typing each line number and pressing RETURN; and the roundabout method of listing to disk or tape the blocks of lines you want to keep, typing NEW, and then reentering the blocks into memory. Both techniques are cumbersome.

Line Deleter offers a better way. It's a little seven-line BASIC routine that takes advantage of *forced-read mode*—the Atari's ability to read information straight off its screen without any human intervention whatsoever. When needed, Line Deleter can be loaded from disk or tape and executed with a single command. As long as your program uses line numbers less than 32760, Line Deleter won't erase any part of it when loaded into memory.

Using Line Deleter

Follow these steps:

1. Type in the listing below and save it on disk or tape with the LIST command, not SAVE or CSAVE. That is, LIST"C:" for cassette or LIST"D:*filename.ext*" for disk.

2. When you're ready to use Line Deleter, load it by typing ENTER"C:" for cassette or ENTER"D: *filename.ext*" for disk.

3. Type GOTO 32761 and press RETURN.

4. Screen prompts ask for three numbers: the beginning line number of the segment to be deleted; the ending line number of the segment; and the intervals between the lines. For example, if your program is numbered by tens, specify ten as the interval. If the program isn't so neatly numbered, you'll need to specify a different interval—perhaps even one. There's no problem if some of the line numbers are nonexistent.

That's it. Just sit back and watch Line Deleter do its stuff. Although it contains no machine language, it's pretty quick—on my 800XL, I've timed it at faster than 3.5 lines per second.

If you're unfamiliar with how the forced-read mode works, don't be disturbed by the STOPPED AT LINE 32764 messages you'll see flashing on the screen. The STOP statement in that line merely keeps the forced-read mode from running amok. You'll also see a CONT statement flashing onscreen; it keeps the routine going.

When Line Deleter is finished, the screen settles down and the usual READY message appears. At this point, you can resume working or use Line Deleter to erase another block of lines in your program. Since Line Deleter is still in memory, you can start with step 3.

Eliminating Interference

Line Deleter uses so little RAM that you may want to keep it in memory at all times while programming. If so, I recommend inserting this line to keep it from interfering with your own program:

```
32760 END
```

This makes absolutely sure that your program won't accidentally run into Line Deleter. However, if you're pushing your Atari's RAM to its limits, you'll want to delete Line Deleter itself. Unfortunately, Line Deleter can't be used for this purpose. If you try, it devours the beginning of its critical FOR-NEXT loop and grinds to a halt. You'll have to erase it using one of the old-fashioned ways described above.

One note of caution: If you're using revision A or revision B Atari BASIC, Line Deleter can trigger the Atari lockup bug. This bug, which has plagued Atari programmers for years, can strike whenever any part of a BASIC program (even a single character) is deleted. There's no practical way to predict when it's going to happen, and usually the only cure is to switch the computer off and back on again—erasing your program, of course. Line Deleter neither increases nor decreases the chances of being bitten by the lockup bug.

If you're unsure which version of BASIC you have, type PRINT PEEK(43234) and press RETURN. If the result is 162, you have revision A; if the result is 96, you have revision B; if the result is 234, you have revision C. The only version free from the lockup bug (and a few other bugs, as well) is revision C, which is built into the 130XE or available as a cartridge for earlier Atari computers.

Line Deleter

For instructions on entering this listing, please refer to "COMPUTE!'s Guide to Typing In Programs" published bimonthly in COMPUTE!.

```
KA 32761 GRAPHICS 0:POSITION
         4,1:? "LINE DELETE
         R":? :?
GD 32762 ? "BEGINNING line n
         umber";:INPUT TOPLN
         O:? "ENDING line nu
         mber";:INPUT BOTLNO
         :? "Intervals";:INP
         UT STPR
MA 32763 FOR LINENO=TOPLNO T
         O BOTLNO STEP STPR
PD 32764 ? CHR$(125):POSITIO
         N 2,4:? LINENO:? "C
         ONT":POSITION 2,0:P
         OKE 842,13:STOP
GD 32765 POKE 842,12
AM 32766 NEXT LINENO
DA 32767 END                  ©
```

Music Hath Charms

Whenever I attend a computer trade show I always look to see which exhibits seem to draw the most people. Generally, companies displaying musical products attract the biggest crowds.

Human beings have a continuing love affair with music that probably started when the first human heard a bird chirping. Each generation develops its own musical tastes, but there is a common thread that runs throughout the life of each of us—we love music.

Given the captivating power of music, it's little wonder that those of us who work with personal computers should want to use them to help us create music of our own. As I recall, the first peripheral I added to my Commodore PET in 1978 was a small amplifier I wired to the serial port of the PIA chip. By running a bit pattern through this port at different speeds, I was able to create simple musical tones. As crude as the sounds were by today's standards, they were musical enough to make the computer play a few compositions.

I was reminded of this project a few weeks ago when I came across my old PET lying in a corner of a closet. If I could have found the issue of the *PET Gazette* that showed how the hookup worked I might have brought the system out again, but my computer music tools have improved a lot since then.

The Ideal Music Interface

When I bought my Apple II in 1979, I played with the sounds I could program through the Apple's built-in speaker. While the sound quality wasn't any better than what I could get with my PET, the built-in speaker in the Apple II motivated software developers to create music programs for this computer.

By the time the Atari 400 and 800 computers came out, musical support was getting much better. Programmers now had four voices to play with, each with independent control of volume and timbre. Even with this improved capability, I wanted more. As I played with the Atari (and, later, the Commodore 64), I remember being excited and frustrated at the same time. I was excited because inexpensive personal computers were capable of generating complex sounds, and frustrated because the tone quality was not as good as I wanted and musical data could not be captured simply by playing it in.

Entering musical notes by typing is cumbersome, and using a joystick is not much of an improvement. To my way of thinking, the personal computer was a wonderful tool for musical expression, but it was missing a natural user interface. Custom keyboards like those from Alpha Syntauri were a step in the right direction, but their cost kept all but professional, or die-hard amateur, musicians from achieving first-rate sounds with their computers.

I moved away from creating music on my personal computers and became more interested in the low-cost synthesizers that were appearing from companies like Casio. While these instruments didn't have the capacity to save my performance or to let me edit and print out a score, they did provide a natural user interface—a piano keyboard—and provided very high quality sound.

The MIDI Breakthrough

Improvements in this field over the last three years have been spectacular. Now, for less than the price of a printer, you can purchase a polyphonic synthesizer that with one press of a button can change from a sixteenth century harpsichord to a space-age tone that sounds like a cross between a Chinese gong and a perturbed elephant.

Synthesizers have extraordinary sound generation capabilities, but they don't have the editing and storage facilities of a personal computer. To bring electronic music to its logical fruition, it seemed that someone would have to find a way to connect synthesizers to computers. Several inventive developers worked on this problem, and the invention of the MIDI interface marked the coming of age for computer-based music systems. Through a high-speed serial port, the MIDI interface allows personal computers to control, and be controlled by, special models of synthesizers. Yamaha and Casio were among the first synthesizer manufacturers to jump on the MIDI bandwagon, and numerous other companies (like Lowrey, Baldwin, and Wurlitzer) have adopted this standard as well.

The inexpensive CZ-101 synthesizer from Casio is one of the most popular MIDI instruments to date. With the CZ-101 (reviewed in this issue), you can create an extraordinary collection of sounds and can save sound libraries on removable cartridges. I have had this synthesizer connected to my Commodore SX-64 through the Passport MIDI card for quite some time. I now enjoy the power and expressive qualities of electronic music without the frustration I had with earlier systems.

Of all the ways personal computers can help people express themselves, the marriage of computers and music may end up being among the most important. Each of us has a song in our hearts, but only a few of us can write music well enough to get this song on paper. Through the interface between the synthesizer and the personal computer, anyone can pick out melodies on a keyboard, see them appear on the display screen, and then edit and refine them until they are just the way we want them. ©

Fred D'Ignazio, Associate Editor

The Ultimate Personal Computer

As a result of my work on a new book, I think I have stumbled onto the ultimate personal computer. *It's a robot!*

I'm working on a science-fiction trilogy for children based on the popular computer game *Robot Odyssey I* from the Learning Company. It's about a 19-year-old boy named Homer Pierce who is kidnapped by robot miners and carried down into Robotropolis, a robot world deep beneath the surface of the earth.

In the year 2005, human beings are surrounded by dozens of intelligent, aware, communicating machines. These artificial minds make all their decisions based on a narrow, specialist (I call it a "little-picture") perspective of the world. None of the machines sees the world from a broader, human perspective.

On his odyssey, the hero, Homer, comes to believe that personal robots can dramatically improve this situation. Homer would like to see people's primary relationship with machines (and technology) be through a *robot friend*. The robot would be a perfect middleman. It deals with the human on a cognitive, logical, and intellectual level, but is also aware of the human's physical, emotional, psychological, ethical, and spiritual nature. And it tries to advise and respond to the human with all these elements in mind. (This makes it a *big-picture machine*.) Then the robot translates what the human wants into commands and requests for all the specialist *little-picture machines*.

The robot friend has a human-like body because the human body is the best-engineered device for general-purpose mobility, sensing, and manipulating the environment. The robot is mobile, therefore, *portable*. It has immense storage and processing capabilities, but is also a *computer terminal* (with a built-in video screen and keyboard) that links a human (through electronic, digital, microwave communications) to the gigantic network of messages, pictures, voices, information, and music which is broadcast and relayed by satellite around the globe. The robot is a personalized, customized interface between the human and this network.

Each robot is fine-tuned to mirror and respond to the needs of its human friend. It becomes that human's private, personal agent. But it is not merely a machine; it's a high-tech, twenty-first century *Man Friday*.

The Primary Robot Friend

As the primary robot becomes more attuned to the needs, personality, and humanity of its human friend, it spreads this awareness to all the little-picture machines it deals with. The primary robot acts as the human's agent, representing the human in all the dimensions of his or her professional and personal life. The robot encourages the machines to personalize their response to the human accordingly.

Also, the robot searches the global network for items of interest to the human being. It keeps these items in storage in the human's personal database (its robot memory—onboard and offboard in a storage closet in the home) and relates the items in newspaper, magazine, or conversational format whenever appropriate. In fact, the personal robot is an excellent conversationalist because: (1) It is extremely interested in anything its human friend has to say, so it is a good listener; (2) It loves to talk about things the human friend is interested in; and (3) It is an inexhaustible source of useful information.

Secondary Robot Friends

The primary robot friend can accompany the human in the car, around town, at the office, and at home. But there are times when this becomes inappropriate or too costly. For those occasions, the human has small *secondary robot friends* to carry around. These robots are usually *laptop* or *pocket robots* which communicate directly with the primary robot friend and act as terminals between the human and the primary robot.

For example, if a human has a business meeting, he may want to take a secondary robot to the meeting and place the robot on the desktop in front of him. The secondary robot acts as a notebook or tape recorder and records the meeting. The human wears a cranial implant, a speaker/microphone biochip which enables him to be in direct, silent communication with the little robot at all times. He can ask the robot questions, have the little robot check with the big robot for advice, information, facts, statistics, and so on. Their "conversation" can be a lot like a conversation a human has with himself—*stream of consciousness*. It can include requests for facts pertinent to the meeting, items for a shopping list, or reminders to take an allergy pill or pick up the kids after school.

The robot is helpful to the human, but it does not take over his thinking. It is merely another voice, another "friend" the human can turn to. It is not to be used as a replacement for the human's own mind, imagination, judgment, or conscience. The robot plays Jiminy Cricket to the human's Pinocchio. The friend never has the authority to make decisions for the human, only to offer information and advice.

What do you think of my idea for the ultimate personal computer? What kind of robot friend or personal computer would *you* like to have? Write me c/o COMPUTE!, P.O. Box 5406, Greensboro, NC 27403.©

The Beginners Page

Tom R. Halfhill, Editor

The Power Of Strings

Last issue we introduced the concept of string variables and briefly hinted at their power—that their ability to hold strings of characters can let your programs manipulate words and sentences instead of just numbers. Consider for a moment how many programs manipulate text in some way: text editors, word processors, database managers, telecommunications programs, educational software, adventure games, even spreadsheets to some extent. Because math isn't the only language humans use to communicate ideas and manipulate information, over the years we've devised ways to make computers handle our alphabets as well.

But keep in mind that digital computers are still number-crunchers at heart. The alphabetic characters which appear on their monitor screens are merely an illusion created for our convenience. Internally, computers see the whole universe in terms of numbers, and they're unaware of anything that can't be translated into numbers. We'll discover some implications of this as we explore the uses of strings in BASIC.

Reducing Redundancy

Probably the simplest way to begin taking advantage of strings in your programs is to use them to save memory and reduce typing. When you assign a string of characters to a string variable (A$="HELLO"), the computer stores the string in a safe place in memory. The string variable is like a bookmarker that reminds the computer where it is keeping the string. From then on, whenever you include that string variable in a BASIC statement, the computer looks up the string of characters in memory and carries out your command. If you print the variable, the entire string appears on the screen.

For example, if there are screen messages that frequently appear in different parts of your program—such as "PRESS ANY KEY TO CONTINUE" or "SELECT NUMBER OF MENU CHOICE"—it's a waste of memory and time to repeatedly type them in as separate PRINT statements. Instead, assign them to string variables like this:

```
10 A$="PRESS ANY KEY TO
   CONTINUE"
20 B$="SELECT NUMBER OF MENU
   CHOICE"
```

and then print the appropriate variable when you need to display the message:

```
100 PRINT A$
```

Here's another example: You've probably seen programs which draw horizontal rows of asterisks or dashes across the screen to make decorative borders, or to separate the screen into different sections for menus and so forth. Obviously it would waste memory to draw these lines with literal PRINT statements, since each PRINT would have to be followed by 40 or 80 characters (depending on the width of your computer's screen display). A better way is to use a FOR-NEXT loop, such as FOR X=1 TO 40:PRINT "*";:NEXT X. But if your program draws these lines often, you might save even more memory by defining a string variable with asterisks or dashes and then just printing the variable whenever you need it. This also executes faster than a FOR-NEXT loop.

Strings With INPUT

Substituting string variables for literal PRINT statements is useful, but you really begin appreciating the power of string variables when you use them as *variables*. Like numeric variables, string variables can be manipulated in dozens of ways.

For instance, with an INPUT statement you can allow the user to assign and reassign characters to a string variable as the program runs—something a literal string can never do. Here's the most common example:

```
10 PRINT "WHAT IS YOUR NAME";
20 INPUT N$
30 PRINT "HELLO, ";N$
40 GOTO 10
```

(Make sure you type the semicolons *outside* the quotation marks in lines 10 and 30, and include the space between the comma and closing quotes in line 30. On Atari computers, don't forget you must always dimension a string variable before its first reference—insert the statement DIM N$(50) with a line number less than 10.)

When you run this program, it prints the message in line 10 and then waits at line 20 until the user types some characters and presses RETURN or ENTER. When the computer detects that RETURN or ENTER is pressed, it assigns whatever characters were typed to the string variable N$. Then it continues to line 30 and prints the HELLO message followed by the characters in N$. Finally, the computer returns to line 10 and lets the user assign a completely new string of characters to N$.

Since the content of N$ is determined by the user, not predetermined by the programmer, this little program can be the basis for a branching routine which takes different actions depending on the user's response. And that, in turn, is the basis for a wide variety of programs which tailor themselves to user input: educational programs that ask a question and evaluate the answer, programs that offer options and accept yes or no choices, programs that request you to specify a filename before loading or saving a data file—just about every kind of program, in fact. We'll take a closer look at these techniques and others in next month's column. ©

INSIGHT: Atari

Bill Wilkinson

Do You Need A 16-Bit Computer?

There has been a disturbing trend in my reader mail for the last couple of months. On the one hand, more and more people are asking for help: Where can I find out how to work with player/missile graphics? How do I hook a model 2300 argon laser to an Atari's joystick ports and shoot down unfriendly flying saucers? (That's not as much an exaggeration of the original question as you may think.) At the same time, and all too often from the same people, I hear of grandiose plans to buy an Atari ST or an Amiga and make the world safe for computocracy. I hate to burst any bubbles, but let's reason together for a moment.

Over the past six years there have been at least 60 or 70 books published about the Atari 8-bit computers. Some are great, some are terrible, and most are at least adequate. True, most of these books are hard to find. Three years ago, the bookshelves had a handful of books about dozens of different kinds of computers. Now, instead, we find dozens of books about a handful of computers. Still, your bookstore can usually order what you need. And if it can't, try an Atari dealer. If that doesn't work, try one of the bigger mail order places that specializes in Atari.

Anyway, here's my point: If you think information about the 8-bit line is sparse, wait until you try to find out anything about the 16-bit machines! As I write this, the only book published so far is called *Presenting the Atari ST*. But don't expect to learn much from it that isn't in Atari's own somewhat skimpy (though attractive) manual. Yes, I have heard of additional books that are "in the works." But how long do you think it will be before there are 60 or 70 titles?

So I'm asking: "Why buy one of the new machines? Why not buy an 800XL or 130XE?" On the basis of price alone, the 8-bit machines win handily. Atari recently announced a special promotion: 130XE, 1050 disk drive, 1027 printer, *AtariWriter*, and DOS 2.5 for $399. Use your TV for the video, throw in a better programming language or business package and a game or two, and you're ready to enjoy computing for about five bills. Try to do the same thing with a 520ST, and you're going to spend about $1,300 to $1,400, presuming you want a color monitor. For an equivalent Amiga, add about $800. What does this extra money buy?

Theory Versus Practice

In theory, the 16-bit machines should run programs 4 to 20 times faster than the 8-bit beasts. In truth, speed depends on the language and how well it is implemented. ST Logo is generally no faster than 8-bit Atari Logo. And for anything except possibly heavy math and intensive disk operations, neither Amiga's ABasiC nor ST BASIC are significantly (i.e., more than 25 percent or so) faster than OSS BASIC XE running on an XL or XE computer.

How about the theories that the new machines can run larger programs, display better graphics, use mouse control, and so on? As I write this, those are mostly just theories, waiting for people to write software and prove them. I have often told people contemplating the purchase of a computer that they should seek out a piece of software to fulfill their needs first, and only then ask what machine(s) it runs on. I cannot emphasize that advice enough for these new computers.

Does this mean that I think everyone should buy 8-bit machines and forget the new ones? Not at all! I simply question whether most people can benefit from their as-yet unrealized potential. And even when their power finally arrives, how many home users will need more than what they get with, say, a 130XE? Business, scientific, and other users may very well need the extra speed and power, but it's pretty hard to justify an extra $500 to $1,500 if all you do with your computer is write a few letters a month and balance your checkbook.

What about people who want to learn how to program? They are total novices on computers, but enthusiasm is a great emptier of the pocketbook. Aside from the fact that there are lots of books on learning how to program an 800XL or 130XE, and none on how to use an ST or Amiga, how hard is it to learn to program on these new wonder machines? Well, writing plain-vanilla BASIC programs without graphics is reasonably easy. But that's easy on the XL and XE machines, also. Simple graphics, with lines and colors? Easy on both kinds of machines. Moving objects? Now we are getting to where it depends on the language: very easy with Atari 8-bit Logo, BASIC XE, and Amiga ABasiC; nearly impossible for a beginner with Atari BASIC or ST BASIC.

I guess I've made my points. As for me, I am moving on to the 16-bit machines. I am ready to learn new and different things, such as how artificial intelligence programs work. Such as how to manipulate multiple screen windows when writing a business application in Pascal. Such as...well, you get the idea. But I still enjoy programming in BASIC. And I still have a library of dozens of programs (mostly public domain and therefore free, or nearly so) which I enjoy on my 130XE. So I won't abandon any of you soon. As for yourself, think hard and read a lot before you abandon your trusty 8-bitter. ©

Telecomputing Today

Arlan R. Levitan

The Face Of Things To Come

Teleconferences via modem (COs) have been around on the various commercial information services for several years. Until recently, COs have typically looked something like this:

(Arlan L.): What kind of computer are you folks using?
(Big Blue): I can't comment on that publicly.
(Jack T.): I'm using an Atari 2600 with Graduate keyboard...I've got a million of 'em.
(T. Leary): I don't need a computer...I'm plugged directly into the network.

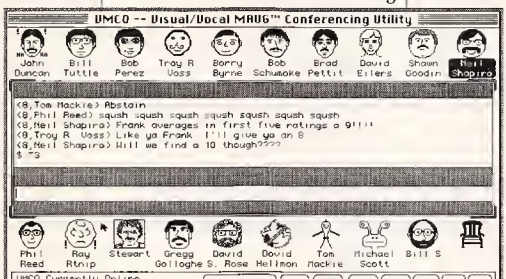
Pretty exciting, eh? Regular readers of this column are already aware that I am no great fan of participating in realtime teleconferencing. The complete transcripts of special "celebrity" COs are often available for perusal in the download sections. The complete text of a CO that went on for several hours can usually be downloaded in about ten minutes.

But now I have a confession to make. I participated in an online conference the other day and nearly split my sides in the process. Before you organize a lynch mob, let me explain.

The unique graphics and voice synthesis capabilities of Apple's Macintosh changed the face of teleconferencing via modem during the summer of 1985. Owners of modem-equipped Macintoshes can participate in conferences in which the faces of the participants appear on-screen, speak, and react to the other conferees.

Visual conferencing was spawned on the Delphi information service when Harry Chesley, a member of IconTact, Delphi's Macintosh SIG, set out to write (in his own words) "an insanely insane" program. Chesley wrote an interface between Apple's public domain *MacinTalk* speech synthesizer program and his own Visual Conference (VCO) telecommunications program. Visual/vocal conferencing was born.

The slickest and most recent incarnation of visual conferencing software is Bob Perez's *VMCO* (Visual/Vocal MAUG Conferencing Utility). *VMCO* was written for use on the conference section of CompuServe's Macintosh forum. While the basic function of Chesley's original is still intact, Perez has polished his implementation into a smooth, multifeatured program.



It's hard to describe the experience of a *VMCO* conference in words, although the phrase "organized lunacy" comes fairly close. The accompanying screen dump shows a 19-person conference in progress. All of the "chairs" in the "conference room" start out empty. As the conference starts to roll, *VMCO* checks the name of conference participants against the face files available on the disk from which *VMCO* was started. If a conferee's face file is found, it is "seated" in one of the chairs. If no face file is found, a generic face is seated instead. As the conferees type away at their keyboards, the words are "spoken" by their faces via *MacinTalk*, replete with lip movement. The conferees may have voices of different pitches and speeds and may also change their faces during the conference to indicate varying emotions.

Getting started with *VMCO* is not without its difficulties. The system is memory-intensive, requiring a 512K Mac. As of October 1985, the only way to design your own face is with a program called a "Resource Editor," which is beyond the experience of most casual Mac users. Then there's the veritable slew of files required: *VMCO*, *MacinTalk*, the Face Files created by other users, and three or four others. If you can't find a friend who already has *VMCO*, you're in for a little over two hours of downloading. Interested? If you're a CompuServe subscriber, the documentation can be found in the telecommunications download section of the MAUG Mac Forum (page PCS-23).

Will visual/vocal conferencing become available on other computers? That's hard to say. The Fat Mac's large memory, icons, and the speed of its Motorola 68000 central processing unit are what makes *VMCO* tick. I doubt that the eight-bit Commodore, Atari, and Apple computers have the oomph needed for visual conferencing. The IBM PC-AT has enough power, but when equipped with a suitable graphics adapter and display, you'll have spent more than eight thousand bucks. That leaves the Atari ST and Amiga as the most likely candidates for future visual conferencing. However, I'm not placing any bets at this time...if I'm wrong I might lose face. ©

Programming the TI

C. Regena

Music And Sound On The TI

Music and sound on the TI can be a lot of fun and fairly easy to program. Some computers require several statements to even play one note, but the TI can play an entire chord with one statement. The best way to learn to program music and sound is to sit at the console and experiment. This month we'll look at a few techniques.

The basic sound statement is CALL SOUND(d,f,v) where d is duration, f is frequency, and v is volume. You may specify more than one frequency and volume for each statement to hear more voices.

The duration parameter tells the computer how many milliseconds (thousandths of a second) the sound should last. CALL SOUND (1000,262,1) plays middle C for exactly one second. You can use this feature for any kind of timing, with or without sound. For example, by setting the volume to the softest and using a high frequency out of hearing range, a program can silently count off seconds.

In music programs it's helpful to use a variable for the duration. For example, let T represent a quarter note. T/2 will be an eighth note, T/3 a triplet, 2*T a half note, 4*T a whole note, and so on. Before the sound statements, define a value for T.

```
110 T=400
120 CALL SOUND(T,262,2)
130 CALL SOUND(T/2,294,2)
140 CALL SOUND(T/2,330,2)
150 CALL SOUND(2*T,349,2)
160 CALL SOUND(4*T,392,2)
170 END
```

To change the tempo, you won't need to change each sound statement, only line 110. For example, change set T=200, then RUN. The tempo changes with all the notes in proportion.

The TI can execute other statements, such as calculations or graphics, while making sounds. Last month's Christmas program is an example of graphics commands being executed among music commands. If another sound statement is encountered, the computer waits until the previous duration is finished. If you want the computer to execute a sound statement without waiting for the previous duration to finish, use a negative number for the duration:

```
110 CALL SOUND(2000,440,2)
120 CALL SOUND(-400,262,2)
130 END
```

The first note should be played for two seconds. However, line 120 includes a negative duration, so its sound starts as soon as the computer gets to line 120, and the sound continues for 400 milliseconds. Negative durations are often placed in a FOR-NEXT loop:

```
110 FOR F=262 TO 392 STEP 12
120 CALL SOUND(-200,F,2)
130 NEXT F
140 END
```

To determine frequency values for notes, consult the charts in the manuals that came with your computer. You can use these charts to translate sheet music. For example, CALL SOUND(1000,440,2) plays A at concert pitch. To play a chord, you can list three frequencies and volumes with one duration in a statement:

```
CALL SOUND(1200,262,2,330,2,392,2)
```

But you're not limited to numbers on the chart. For example, the frequency for middle C is 262, and the frequency for D is 294. You can play any tone between these notes:

```
110 FOR F=262 to 294
120 CALL SOUND(300,F,2)
130 PRINT F
140 NEXT F
150 END
```

By varying the frequency in a FOR-NEXT loop, you can create interesting sound effects:

```
110 FOR F=440 TO 523 STEP 15
120 CALL SOUND(-100,F,2)
130 NEXT F
140 FOR F=262 TO 131 STEP -10
150 CALL SOUND(-100,F,2)
160 NEXT F
170 END
```

Create noises by using negative frequencies from -1 to -8. These noises can be fun to add to games. However, you're not limited to just these noises. You may combine up to three other frequencies with one noise—you can spend days experimenting with different combinations to make different noises. Try these examples:

```
CALL SOUND(1000,-6,2,440,2)
CALL SOUND(1000,-6,2,262,2)
CALL SOUND(1000,-6,2,131,2,165,2)
```

The volume parameter may be a value from 0 (loudest) to 30 (softest). You can assign different volumes to notes to create dynamics, such as a crescendo, or to make a melody more prominent.

```
110 CALL SOUND(400,262,8)
120 CALL SOUND(400,294,6)
130 CALL SOUND(400,330,4)
140 CALL SOUND(400,349,2)
150 CALL SOUND(800,392,0)
160 END
```

Try varying the volume in loops to create sound effects:

```
110 FOR V=0 TO 30
120 CALL SOUND(-100,262,V)
130 NEXT V
140 FOR V=30 TO 0 STEP -1
150 CALL SOUND(-100,-5,V)
160 NEXT V
170 FOR V=0 TO 30
180 CALL SOUND(-100,-6,V)
190 NEXT V
200 FOR F=262 TO 330 STEP 34
210 FOR V=0 TO 30
220 CALL SOUND(-100,F,V,-6,V)
230 NEXT V
240 NEXT F
250 END
```

CALL SOUND is quite versatile and can add a lot to your programs. Take the time to experiment and you'll discover that you can create all kinds of sounds with your TI. C

Donald B. Trivette

Last Minute Gifts

This is the first column of 1986 and a good place to tell you about three products for the IBM PC and PCjr that didn't fit into last year's columns, but which make great gifts.

Realia (pronounced Ree-AL-ia) has a program called *SpaceMaker* that actually compresses the size of programs so you can get more on a disk. *SpaceMaker* reduces the size of *most* program files—those ending in .COM or .EXE—but cannot compress data files. For example, it reduces the size of the IBM spelling checker *Word Proof*, but cannot reduce the size of *Word Proof*'s dictionary file.

At the technical level, *SpaceMaker* removes all the binary zeros from a program and writes them in a compact form. It then appends a little-bitty (pun intended) program to the beginning of the file. When DOS loads the file—when you type the name of the program—the tiny preprogram takes control and reconstructs the binary zeros as it loads and runs the bigger program. All this happens automatically.

SpaceMaker is so simple to use that you don't have to know anything about binary zeros or programming. All you need do is enter the input filename and the output filename and *SpaceMaker* does the rest. It generates a new, smaller program file which works just like the old one; the output filename is the new program name. As always, it's best to keep the original copy of a program on one disk and the *SpaceMaker*-squeezed copy on another.

Here are some typical space savings:

Program	Original size	New size	Reduction
IBM Personal Editor	45,696	41,728	8%
Word Proof	27,056	24,616	9%
PC-Talk III (compiled version)	81,408	66,880	17%
Lotus 1-2-3 (1A)	89,984	80,000	11%
BASICA.COM	[Won't compress]		

SpaceMaker retails for $75 and is produced by Realia, Inc., 10 South Riverside Plaza, Chicago, IL, 60606. It requires a PC or PCjr with a disk drive.

A Hidden Typewriter

Even if you dislike desk-management software as much as I do, you might like *ProType*. It hides in memory like desk-management software until you need it, then is brought forth by pressing the ALT key twice. A *1-2-3*-like menu appears at the top of the screen. Selecting the Type option puts the program in typewriter mode. Any line typed on the computer goes to the printer. This is the mode I use most of the time: it's perfect for addressing envelopes and mailing labels. Pressing the ESC key sends *ProType* back into memory, where it occupies about 28,000 bytes, and returns you to your regularly scheduled program. I can whip out an envelope from the middle of *1-2-3* in 15 seconds!

Even if you dislike desk-management software as much as I do, you might like *ProType*.

But there's more to *ProType* than type mode. You can enter edit mode and compose and print (but not save) a one-page memo or letter. You can also create a template and use *ProType* to type forms, such as invoices, statements, and checks. Another command sends escape codes to the printer.

I'm amazed that it works happily with all the other things I have hiding in memory, namely a print spooler, a screen-blank-after-five-minutes program, a RAM disk, a keyboard enhancer, and a disk drive analyzer.

ProType retails for $69 and is from Photon Software, 14021 NE 8th Street, Bellevue, WA, 98009. It requires a PC or PCjr with a disk drive.

Portable Sound

The third product is for PCjr owners who don't have a monitor with a built-in speaker and don't want to drag a stereo amp and hi-fi speakers to Junior's location. I'm in this group, so I've never been able to hear the wonderful sound effects, for example, in the *King's Quest* games. What I needed was an inexpensive amplifier-speaker that I could plug into the audio jack on Junior's backside.

I've found one. Radio Shack sells a battery-operated 200-milliwatt amplifier-speaker (catalog number 277-1008B) that's perfect and costs only $12. To hook it up to a PCjr, you'll need a cable (miniphono to RCA plug) which costs about $2 at Radio Shack. ©

COMPUTE!'s Guide To Typing In Programs

Before typing in any program, you should familiarize yourself with your computer. Learn how to use the keyboard to type in and correct BASIC programs. Read your manuals to understand how to save and load BASIC programs to and from your disk drive or cassette unit. Computers are precise—take special care to type the program *exactly* as listed, including any necessary punctuation and symbols, except for special characters as noted below. To help you with this task, we have implemented a special listing convention as well as a program to help check your typing—the "Automatic Proofreader." Please read the following notes before typing in any programs from COMPUTE!. They can save you a lot of time and trouble.

Commodore, Apple, and Atari programs can contain some hard-to-read (and hard-to-type) special characters, so we have developed a listing system that indicates the function of these control characters. (There are no special control characters in our IBM or TI-99/4A listings.) You will find Commodore and Atari special characters within curly braces; *do not type the braces.* For example, {CLEAR} or {CLR} instructs you to insert the symbol which clears the screen on the Atari or Commodore machines. For Commodore, Apple, and Atari, a symbol by itself within curly braces is usually a control key or graphics key. If you see {A}, hold down the CTRL key and press A. This will produce a reverse video character on the Commodore (in quote mode), a graphics character on the Atari, and an invisible control character on the Apple. Commodore computers also have a special control key labeled with the Commodore logo. Graphics characters entered with the Commodore logo key are enclosed in a special bracket that looks like this: [<A>]. In this case, you would hold down the Commodore logo key as you type A. Our Commodore listings are in uppercase, so shifted symbols are underlined. A graphics heart symbol (SHIFT-S) would be listed as S. One exception is {SHIFT-SPACE}. When you see this, hold down SHIFT and press the space bar. If a number precedes a symbol, such as {5 RIGHT}, {6 S}, or [<8 Q>], you would enter five cursor rights, six shifted S's, or eight Commodore-Q's. On the Atari, inverse characters (printed in white on black) should be entered after pressing the inverse video key.

Since spacing is sometimes important, any more than two spaces will be listed. For example, {6 SPACES} means to press the space bar six times. Our listings never leave a space at the end of a line, instead moving it to the next printed line as {SPACE}. For your convenience, we have prepared this quick-reference chart for the Commodore and Atari special characters:

Atari 400/800/XL/XE

When you see	Type	See	
{CLEAR}	ESC SHIFT <		Clear Screen
{UP}	ESC CTRL -		Cursor Up
{DOWN}	ESC CTRL =		Cursor Down
{LEFT}	ESC CTRL +		Cursor Left
{RIGHT}	ESC CTRL *		Cursor Right
{BACK S}	ESC DELETE		Backspace
{DELETE}	ESC CTRL DELETE		Delete character
{INSERT}	ESC CTRL INSERT		Insert character
{DEL LINE}	ESC SHIFT DELETE		Delete line
{INS LINE}	ESC SHIFT INSERT		Insert line
{TAB}	ESC TAB		TAB key
{CLR TAB}	ESC CTRL TAB		Clear tab
{SET TAB}	ESC SHIFT TAB		Set tab stop
{BELL}	ESC CTRL 2		Ring buzzer
{ESC}	ESC ESC		ESCape key

Commodore PET/CBM/VIC/64/128/16/+4

When You Read:	Press:	See:	When You Read:	Press:	See:
{CLR}	SHIFT CLR/HOME		[<1>]	COMMODORE 1	
{HOME}	CLR/HOME		[<2>]	COMMODORE 2	
{UP}	SHIFT ↑ CRSR ↓		[<3>]	COMMODORE 3	
{DOWN}	↑ CRSR ↓		[<4>]	COMMODORE 4	
{LEFT}	SHIFT ← CRSR →		[<5>]	COMMODORE 5	
{RIGHT}	← CRSR →		[<6>]	COMMODORE 6	
{RVS}	CTRL 9		[<7>]	COMMODORE 7	
{OFF}	CTRL 0		[<8>]	COMMODORE 8	
{BLK}	CTRL 1		{ F1 }	f1	
{WHT}	CTRL 2		{ F2 }	SHIFT f1	
{RED}	CTRL 3		{ F3 }	f3	
{CYN}	CTRL 4		{ F4 }	SHIFT f3	
{PUR}	CTRL 5		{ F5 }	f5	
{GRN}	CTRL 6		{ F6 }	SHIFT f5	
{BLU}	CTRL 7		{ F7 }	f7	
{YEL}	CTRL 8		{ F8 }	SHIFT f7	
			←	←	

The Automatic Proofreader

We have developed a series of simple, yet effective programs that can help check your typing. Type in the appropriate Proofreader program listed below, then save it for future use. On the VIC, 64, or Atari, run the Proofreader to activate it, then enter NEW to erase the BASIC loader (the Proofreader remains active, hidden in memory, as a machine language program). Pressing RUN/STOP–RESTORE or SYSTEM RESET deactivates the Proofreader. You can use SYS 886 to reactivate the VIC/64 Proofreader, or PRINT USR(1536) to reenable the Atari Proofreader. On the Apple, the Proofreader automatically erases the BASIC portion of itself after you activate it by typing RUN, leaving only the machine language portion in memory. It works with either DOS 3.3 or ProDOS. Disable the Apple Proofreader by pressing CTRL-RESET before running another BASIC program. The IBM Proofreader is a BASIC program that simulates the IBM BASIC line editor, letting you enter, edit, list, save, and load programs that you type. Type RUN to activate.

Once the Proofreader is active, try typing in a line. As soon as you press RETURN, either a decimal number (on the Commodore), a hexadecimal number (on the Apple), or a pair of letters (on the Atari or IBM) appears. The number or pair of letters is called a *checksum*. Try making a change in the line, and notice how the checksum changes.

All you need to do is compare the value provided by the Proofreader with the checksum printed in the program listing in the magazine. In Commodore listings, the checksum is a number from 0 to 255. It is set off from the rest of the line with *rem*. This prevents a syntax error if the checksum is typed in, but the REM statements and checksums need *not* be typed in. It is just there for your information.

In Atari, Apple, and IBM listings, the checksum is given to the left of each line number. Just type in the program one line at a time (without the printed checksum) and compare the checksum generated by the Proofreader to the checksum in the listing. If they match, go on to the next line. If not, check your typing: You've made a mistake. On the Commodore, Atari, and Apple Proofreaders, spaces are not counted as part of the checksum, so be sure you type the right number of spaces between quote marks. The Commodore and Atari Proofreaders do not check to see that you've typed the characters in the right order, so if characters are transposed, the checksum still matches the listing. Because of the checksum method used, do not type abbreviations, such as ? for PRINT. The IBM Proofreader is the pickiest of all; it *will* detect errors in spacing and transposition. Be sure to leave Caps Lock on, except when typing lowercase characters.

IBM Proofreader Commands

Since the IBM Proofreader replaces the computer's normal BASIC line editor, it has to include many of the direct-mode IBM BASIC commands. The syntax is identical to IBM BASIC. Commands simulated are LIST, LLIST, NEW, FILES, SAVE, and LOAD. When listing your program, press any key (except Ctrl-Break) to stop the listing. If you type NEW, the Proofreader prompts you to press Y to be sure you mean yes.

Two new commands are BASIC and CHECK. BASIC exits the Proofreader back to IBM BASIC, leaving the Proofreader in memory. CHECK works just like LIST, but shows the checksums along with the listing. After you have typed in a program, save it to disk. Then exit the Proofreader with the BASIC command, and load the program in BASIC as usual (this replaces the Proofreader in memory). You can now run the program, but you may want to resave it to disk. The version of your program that you resave from BASIC will take up less space on disk and will load faster, but it can no longer be edited with the Proofreader. If you want to convert a program to Proofreader format, save it to disk with SAVE *"filename"*,A.

Special Proofreader Notes For Commodore Cassette Users

The Proofreader resides in a section of memory called the cassette buffer, which is used during tape LOADs and SAVEs. Therefore, be sure to press RUN/STOP–RESTORE to get the Proofreader out of the way before saving or loading a program. If you want to use the Proofreader with tape, run the Proofreader, then enter these two lines *exactly* as shown, pressing RETURN after each one:

```
A$="PROOFREADER.T":B$="{10
  SPACES}":FOR X=1 TO 4:A$=A$
  +B$:NEXT
 FOR X=886 TO 1018:A$=A$+CHR$
(PEEK(X)):NEXT:OPEN 1,1,1,A$:
  CLOSE1
```

Then insert a blank tape and press RECORD and PLAY to save a special version of the Proofreader. Anytime you need to reload the Proofreader after it has been erased—for example, after you reload a paritally completed program—just rewind the tape, type OPEN1:CLOSE1, then press PLAY. You'll see the message FOUND PROOFREADER.T, but not the familiar LOADING message. Don't worry; the Proofreader is in memory. When READY comes back, enter SYS 886.

Program 1: VIC/64 Proofreader

By Charles Brannon, Program Editor

```
10 PRINT"{CLR}PLEASE WAIT...":
   FORI=886TO1018:READA:CK=CK+
   A:POKEI,A:NEXT
20 IF CK<>17539 THEN PRINT" \
   {DOWN}YOU MADE AN ERROR":PR
   INT"IN DATA STATEMENTS.":EN
   D
30 SYS886:PRINT"{CLR}{2 DOWN}P
   ROOFREADER ACTIVATED.":NEW
40 DATA 173,036,003,201,150,20
   8,001,096,141,151,003,173
50 DATA 037,003,141,152,003,16
   9,150,141,036,003,169,003
60 DATA 141,037,003,169,000,13
   3,254,096,032,087,241,133
70 DATA 251,134,252,132,253,00
   8,201,013,240,017,201,032
80 DATA 240,005,024,101,254,13
   3,254,165,251,166,252,164
90 DATA 253,040,096,169,013,03
   2,210,255,165,214,141,251
100 DATA 003,206,251,003,169,0
    00,133,216,169,019,032,210
110 DATA 255,169,018,032,210,2
    55,169,58,032,210,255,166
120 DATA 254,169,000,133,254,1
    72,151,003,192,087,208,006
130 DATA 032,205,189,076,235,0
    03,032,205,221,169,032,032
140 DATA 210,255,032,210,255,1
    73,251,003,133,214,076,173
150 DATA 003
```

Program 2: Atari Proofreader

By Charles Brannon, Program Editor

```
100 GRAPHICS 0
110 FOR I=1536 TO 1700:RE
    AD A:POKE I,A:CK=CK+A
    :NEXT I
120 IF CK<>19072 THEN ? "
    Error in DATA Stateme
    nts.  Check Typing.":
    END
130 A=USR(1536)
140 ? :? "Automatic Proof
    reader Now Activated.
    "
150 END
160 DATA 104,160,0,185,26
    ,3,201,69,240,7
170 DATA 200,200,192,34,2
    08,243,96,200,169,74
180 DATA 153,26,3,200,169
    ,6,153,26,3,162
190 DATA 0,189,0,228,157,
    74,6,232,224,16
200 DATA 208,245,169,93,1
    41,78,6,169,6,141
210 DATA 79,6,24,173,4,22
    8,105,1,141,95
```

```
220 DATA 6,173,5,228,105,
    0,141,96,6,169
230 DATA 0,133,203,96,247
    ,238,125,241,93,6
240 DATA 244,241,115,241,
    124,241,76,205,238
250 DATA 0,0,0,0,0,0,32,62,
    246,8,201
260 DATA 155,240,13,201,3
    2,240,7,72,24,101
270 DATA 203,133,203,104,
    40,96,72,152,72,138
280 DATA 72,160,0,169,128
    ,145,88,200,192,40
290 DATA 208,249,165,203,
    74,74,74,74,24,105
300 DATA 161,160,3,145,88
    ,165,203,41,15,24
310 DATA 105,161,200,145,
    88,169,0,133,203,104
320 DATA 170,104,168,104,
    40,96
```

Program 3: IBM Proofreader

By Charles Brannon, Program Editor

```
10 'Automatic Proofreader Ver
   sion 2.00 (Lines 270,510,5
   15,517,620,630 changed fro
   m V1.0)
100 DIM L$(500),LNUM(500):COL
   OR 0,7,7:KEY OFF:CLS:MAX=
   0:LNUM(0)=65536!
110 ON ERROR GOTO 120:KEY 15,
   CHR$(4)+CHR$(70):ON KEY(1
   5) GOSUB 640:KEY (15) ON:
   GOTO 130
120 RESUME 130
130 DEF SEG=&H40:W=PEEK(&H4A)
140 ON ERROR GOTO 650:PRINT:P
   RINT"Proofreader Ready."
150 LINE INPUT L$:Y=CSRLIN-IN
   T(LEN(L$)/W)-1:LOCATE Y,1
160 DEF SEG=0:POKE 1050,30:PO
   KE 1052,34:POKE 1054,0:PO
   KE 1055,79:POKE 1056,13:P
   OKE 1057,28:LINE INPUT L$
   :DEF SEG:IF L$="" THEN 15
   0
170 IF LEFT$(L$,1)=" " THEN L
   $=MID$(L$,2):GOTO 170
180 IF VAL(LEFT$(L$,2))=0 ANO
    MID$(L$,3,1)=" " THEN L$
   =MID$(L$,4)
190 LNUM=VAL(L$):TEXT$=MID$(L
   $,LEN(STR$(LNUM))+1)
200 IF ASC(L$)>57 THEN 260 'n
   o line number, therefore
   command
210 IF TEXT$="" THEN GOSUB 54
   0:IF LNUM=LNUM(P) THEN GO
   SUB 560:GOTO 150 ELSE 150
220 CKSUM=0:FOR I=1 TO LEN(L$
   ):CKSUM=(CKSUM+ASC(MID$(L
   $,I))*I) AND 255:NEXT:LOC
   ATE Y,1:PRINT CHR$(65+CKS
   UM/16)+CHR$(65+(CKSUM ANO
   15))+" "+L$
230 GOSUB 540:IF LNUM(P)=LNUM
    THEN L$(P)=TEXT$:GOTO 15
   0 'replace line
240 GOSUB 580:GOTO 150 'inser
   t the line
260 TEXT$="":FOR I=1 TO LEN(L
   $):A=ASC(MID$(L$,I)):TEXT
   $=TEXT$+CHR$(A+32*(A>96 A
   ND A<123)):NEXT
270 OELIMITER=INSTR(TEXT$," "
   ):COMMAND$=TEXT$:ARG$="":
   IF OEL1MITER THEN COMMANO
   $=LEFT$(TEXT$,OEL1MITER-1
   ):ARG$=MID$(TEXT$,OEL1MIT
   ER+1) ELSE OEL1MITER=INST
   R(TEXT$,CHR$(34)):IF OEL1
   MITER THEN COMMAND$=LEFT$
   (TEXT$,DEL1MITER-1):ARG$=
   MID$(TEXT$,DEL1MITER)
280 IF COMMANO$<>"LIST" THEN
   410
290 OPEN "scrn:" FOR OUTPUT A
   S #1
300 IF ARG$="" THEN FIRST=0:P
   =MAX-1:GOTO 340
310 OELIMITER=INSTR(ARG$,"-")
   :IF DEL1MITER=0 THEN LNUM
   =VAL(ARG$):GOSUB 540:FIRS
   T=P:GOTO 340
320 FIRST=VAL(LEFT$(ARG$,OEL1
   MITER)):LAST=VAL(MID$(ARG
   $,OEL1MITER+1))
330 LNUM=FIRST:GOSUB 540:FIRS
   T=P:LNUM=LAST:GOSUB 540:I
   F P=0 THEN P=MAX-1
340 FOR X=FIRST TO P:N$=MID$(
   STR$(LNUM(X)),2)+" "
350 IF CKFLAG=0 THEN A$="":GO
   TO 370
360 CKSUM=0:A$=N$+L$(X):FOR I
   =1 TO LEN(A$):CKSUM=(CKSU
   M+ASC(MID$(A$,I))*I) AND
   255:NEXT:A$=CHR$(65+CKSUM
   /16)+CHR$(65+(CKSUM AND 1
   5))+" "
370 PRINT #1,A$+N$+L$(X)
380 IF INKEY$<>"" THEN X=P
390 NEXT :CLOSE #1:CKFLAG=0
400 GOTO 130
410 IF COMMANO$="LLIST" THEN
   OPEN "lpt1:" FOR OUTPUT A
   S #1:GOTO 300
420 IF COMMANO$="CHECK" THEN
   CKFLAG=1:GOTO 290
430 IF COMMAND$<>"SAVE" THEN
   450
440 GOSUB 600:OPEN ARG$ FOR O
   UTPUT AS #1:ARG$="":GOTO
   300
450 IF COMMANO$<>"LDAO" THEN
   490
460 GOSUB 600:OPEN ARG$ FOR I
   NPUT AS #1:MAX=0:P=0
470 WHILE NOT EOF(1):LINE INP
   UT #1,L$:LNUM(P)=VAL(L$):
   L$(P)=MID$(L$,LEN(STR$(VA
   L(L$)))+1):P=P+1:WENO
480 MAX=P:CLOSE #1:GOTO 130
490 IF COMMAND$="NEW" THEN IN
   PUT "Erase program - Are
   you sure";L$:IF LEFT$(L$,
   1)="y" DR LEFT$(L$,1)="Y"
    THEN MAX=0:GOTO 130:ELSE
   130
500 IF COMMANO$="BASIC" THEN
   COLOR 7,0,0:ON ERROR GOTO
    0:CLS:END
510 IF COMMAND$<>"FILES" THEN
   520
515 IF ARG$="" THEN ARG$="A:"
    ELSE SEL=1:GOSUB 600
517 FILES ARG$:GOTO 130
520 PRINT"Syntax error":GOTO
   130
540 P=0:WHILE LNUM>LNUM(P) AN
   D P<MAX:P=P+1:WENO:RETURN
560 MAX=MAX-1:FOR X=P TO MAX:
   LNUM(X)=LNUM(X+1):L$(X)=L
   $(X+1):NEXT:RETURN
580 MAX=MAX+1:FOR X=MAX TO P+
   1 STEP -1:LNUM(X)=LNUM(X-
   1):L$(X)=L$(X-1):NEXT:L$(
   P)=TEXT$:LNUM(P)=LNUM:RET
   URN
600 IF LEFT$(ARG$,1)<>CHR$(34
   ) THEN 520 ELSE ARG$=MID$
   (ARG$,2)
610 IF RIGHT$(ARG$,1)=CHR$(34
   ) THEN ARG$=LEFT$(ARG$,LE
   N(ARG$)-1)
620 IF SEL=0 AND INSTR(ARG$,"
   .")=0 THEN ARG$=ARG$+".BA
   S"
630 SEL=0:RETURN
640 CLOSE #1:CKFLAG=0:PRINT"S
   topped.":RETURN 150
650 PRINT "Error #";ERR:RESUM
   E 150
```

Program 4: Apple Proofreader

By Tim Victor, Editorial Programmer

```
10 C = 0: FOR I = 768 TO 768 +
   68: READ A:C = C + A: POKE 1
   ,A: NEXT
20 IF C < > 7258 THEN PRINT "ER
   ROR IN PRODFREADER DATA STAT
   EMENTS": END
30 IF PEEK (190 * 256) < > 76 T
   HEN POKE 56,0: POKE 57,3: CA
   LL 1002: GOTO 50
40 PRINT CHR$ (4);"IN#A$300"
50 POKE 34,0: HOME : POKE 34,1:
    VTAB 2: PRINT "PRDOFREADER
   INSTALLED"
60 NEW
100 DATA 216,32,27,253,201,141
110 DATA 208,60,138,72,169,0
120 DATA 72,189,255,1,201,160
130 DATA 240,8,104,10,125,255
140 DATA 1,105,0,72,202,208
150 DATA 238,104,170,41,15,9
160 DATA 48,201,58,144,2,233
170 DATA 57,141,1,4,138,74
180 DATA 74,74,74,41,15,9
190 DATA 48,201,58,144,2,233
200 DATA 57,141,0,4,104,170
210 DATA 169,141,96
```

MLX Machine Language Entry Program For Commodore 64 and Apple

"MLX" allows almost failsafe entry of machine language (ML) programs published in COMPUTE!. *The Apple version runs on all II-series computers with either DOS 3.3 or ProDOS. The current Commodore 64 version was introduced in the December 1985 issue; no version of 64 MLX published before that date can be used to enter the MLX-format listings published since then.*

Type in and save some copies of the version of MLX for your computer (you'll need it for entering future ML programs in COMPUTE!). For Apple MLX, it doesn't matter whether you save the program on a disk formatted for DOS 3.3 or ProDOS. Programs entered with Apple MLX, however, must be saved to a disk formatted with the same operating system as MLX itself. If you have an Apple IIe or IIc, make sure the CAPS LOCK key is down.

When you're ready to enter an ML program, load and run MLX. It asks you for a starting address and ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing. After you enter the addresses, 64 MLX offers you the option of clearing the workspace. Choose this option only if you're starting to enter a new listing.

A functions menu appears next. The first option is Enter Data. If you're just starting to type in a program, pick this. Begin by typing the first number in the first line of the program listing. If you've already typed in part of a program, type the line number where you left off typing at the end of the previous session. In any case, make sure the address you enter corresponds to the address of a line in the listing you are entering. Otherwise, you'll be unable to enter the data correctly. In 64 MLX, if you select Enter Data by mistake, you can return to the menu by pressing RETURN alone when asked for the address. (You can get back to the menu from most options by pressing RETURN with no other input.)

Once in Enter mode, MLX prints the address for each program line. You then type in all numbers on that line, beginning with the first two-digit number after the colon (:). Each line represents eight data bytes and a checksum. Although an MLX-format listing appears similar to the "hex dump" ML listings you may have seen, the extra checksum number on the end allows MLX to check your typing.

Only the numerals 0–9 and the letters A–F can be typed. If you press any other key (with some exceptions noted below), nothing happens. When you enter a line correctly, MLX adds the data to the workspace area and prompts for the next line (the 64 version also beeps). But if MLX detects a typing error, it notifies you. 64 MLX buzzes and displays an error message, then redisplays the line for editing. Apple MLX beeps, erases the incorrect line, and prompts you to reenter it.

64 MLX formats your input for you, so you may have to unlearn some habits. Do *not* type spaces between the columns; 64 MLX automatically inserts them. Do *not* press RETURN after typing the last number in a line; 64 MLX automatically enters and checks the line after you type the last digit.

Apple MLX is a little different. You can put extra spaces between numbers or leave out the spaces entirely, compressing a line into 18 keypresses. But be careful not to put a space between two digits in the middle of a number. Apple MLX would read two single-digit numbers instead of one two-digit number. You must press RETURN to enter the line.

In 64 MLX, to correct typing mistakes before finishing a line, press INST/DEL to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a whole line, press CLR/HOME to start the line over. The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, 64 MLX disables RETURN until the cursor returns to the start of a line. You can press CLR/HOME to quickly get to a line number prompt.

When 64 MLX detects an error, more editing features become available. Compare the erroneous line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. The cursor-left and -right keys provide the normal cursor controls. (INST/DEL now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, the line is reentered. During editing, RETURN is active; pressing it tells 64 MLX to recheck the line. You can press CLR/HOME to clear the entire line if you want to start over, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Apple MLX also has editing features. The left- and right-arrow keys let you back up and go forward on the line you're entering so you can retype data. Pressing the CTRL and D keys simultaneously removes the character under the cursor, shortening the line by one character. Pressing CTRL-I inserts a space under the cursor and shifts the rest of the line to the right, making the line one character longer. If the cursor is at the right end of the line, neither CTRL-D nor CTRL-I has any effect. To leave Enter mode, press RETURN when MLX prompts you for a new line.

After you've entered the last number on the last line of the listing, Apple MLX returns to the menu. Immediately choose option S to save your data. 64 MLX automatically moves to the Save option after you type the last number.

Another menu choice, Display Data, shows the contents of memory in the same format as the listing (including the checksum). When you press D, MLX asks you for a starting address. Be sure the address you give matches a line number in the listing. Otherwise, the checksum display is meaningless. MLX displays lines until it reaches the end of the program, then redisplays the menu. With Apple MLX, you can stop the display and return to the menu by pressing any key. 64 MLX lets you stop the display and get back to the menu by pressing RETURN, or pause the display by pressing the space bar (press space again to unpause).

Two more menu selections let you save and load partially typed programs: Save File and Load File in Apple MLX, and Save Data and Load Data in 64 MLX. When you press S or L, MLX asks you for the filename. 64 MLX follows this by asking you to press either D or T for disk or tape. 64 MLX starts and stops the disk drive several times during a load or save; this is normal. Also, 64 MLX automatically adds the drive prefix 0: to the filename, so *do not* include this when entering the filename.

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small part of a long listing. When saving a partial listing, make sure to note the address where you stopped typing so you'll know where to resume when you reload.

MLX reports any errors detected during the save or load. 64 MLX displays standard error messages and has

three special load error messages: INCORRECT STARTING ADDRESS, which means the file you're loading does not have the starting address you specified when you ran MLX; LOAD ENDED AT *address*, which means the file you're loading ends before the ending address you specified when you started MLX; and TRUNCATED AT ENDING ADDRESS, which means the file you're loading extends beyond the ending address you specified when you started MLX.

Apple MLX simply displays the message DISK ERROR if it detects a problem during a Save or Load. If you're unsure what caused the error, check the drive. Make sure there's a disk formatted by the same operating system you're using for MLX (ProDOS or DOS 3.3). You'll also see an error message if the disk is full. Either save the file on another disk or quit MLX by pressing the Q key, delete an old file or two, then rerun MLX. Your typing should still be safe in memory. If the error message appears during a Load, make sure the filename exists on disk. An error message when the program isn't trying to access the drive means you've made a typing error in the MLX program itself.

The Quit option stops MLX and enters BASIC. (Of course, RUN/STOP–RESTORE for the 64 or CTRL-RESET for the Apple also quits.) 64 MLX asks for verification; press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN and reenter MLX without losing your data, as long as you don't use the clear workspace option in 64 MLX.

The instructions for loading and using the finished listing vary from program to program. Some Commodore 64 ML programs are designed to be loaded and run like BASIC programs. Others must be reloaded to specific addresses, then started with a SYS. Always refer to the article which accompanies the ML listing for this information. For the Apple, you need to either BRUN the program, or BLOAD and start the program with a CALL. Again, refer to the article accompanying the program.

For instructions on entering the following listings, please refer to "COMPUTE!'s Guide to Typing In Programs" published in this issue of COMPUTE!.

Program 1: MLX For Commodore 64

Version by Ottis Cowper, Technical Editor

```
100 POKE 56,50:CLR:DIM IN$,I,J
    ,A,B,A$,B$,A(7),N$ :rem 34
110 C4=4B:C6=16:C7=7:Z2=2:Z4=2
    54:Z5=255:Z6=256:Z7=127
                       :rem 238
120 FA=PEEK(45)+Z6*PEEK(46):BS
    =PEEK(55)+Z6*PEEK(56):H$="
    0123456789ABCDEF" :rem 11B
130 R$=CHR$(13):L$="{LEFT}":S$
    =" ":D$=CHR$(20):Z$=CHR$(0
    ):T$="{13 RIGHT}" :rem 173
140 SD=54272:FOR I=SD TO SD+23
    :POKE I,0:NEXT:POKE SD+24,
    15:POKE 7BB,52     :rem 194
150 PRINT"{CLR}"CHR$(142)CHR$(
    B):POKE 53280,15:POKE 5328
    1,15               :rem 104
160 PRINT T$" {RED}{RVS}
    {2 SPACES}§8 @¾{2 SPACES}"
    SPC(28)"{2 SPACES}{OFF}
    {BLU} MLX II {RED}{RVS}
    {2 SPACES}"SPC(28)"
    {12 SPACES}{BLU}" :rem 121
170 PRINT"{3 DOWN}{3 SPACES}CO
    MPUTE!'S MACHINE LANGUAGE
    {SPACE}EDITOR{3 DOWN}"
                       :rem 135
180 PRINT"{BLK}STARTING ADDRES
    S§4¾";:GOSUB300:SA=AD:GOSU
    B1040:IF F THEN180:rem 113
190 PRINT"{BLK}{2 SPACES}ENDIN
    G ADDRESS§4¾";:GOSUB300:EA
    =AD:GOSUB1030:IF F THEN190
                       :rem 173
200 INPUT"{3 DOWN}{BLK}CLEAR W
    ORKSPACE [Y/N]§4¾";A$:IF L
    EFT$(A$,1)<>"Y"THEN220
                       :rem 9
210 PRINT"{2 DOWN}{BLU}WORKING
    ...";:FORI=BS TO BS+EA-SA+
    7:POKE I,0:NEXT:PRINT"DONE
    "                  :rem 139
220 PRINTTAB(10)"{2 DOWN}{BLK}
    {RVS} MLX COMMAND MENU
    {DOWN}§4¾":PRINT T$"{RVS}E
    {OFF}NTER DATA"    :rem 62
230 PRINT T$"{RVS}D{OFF}ISPLAY
     DATA":PRINT T$"{RVS}L
    {OFF}OAD DATA"     :rem 19
240 PRINT T$"{RVS}S{OFF}AVE FI
    LE":PRINT T$"{RVS}Q{OFF}UI
    T{2 DOWN}{BLK}"    :rem 238
250 GET A$:IF A$=N$ THEN250
                       :rem 127
260 A=0:FOR I=1 TO 5:IF A$=MID
    $("EDLSQ",I,1)THEN A=I:I=5
                       :rem 42
270 NEXT:ON A GOTO420,610,690,
    700,280:GOSUB1060:GOTO250
                       :rem 97
280 PRINT"{RVS} QUIT ":INPUT"
    {DOWN}§4¾ARE YOU SURE [Y/N
    ]";A$:IF LEFT$(A$,1)<>"Y"T
    HEN220             :rem 1B9
290 POKE SD+24,0:END   :rem 95
300 IN$=N$:AD=0:INPUTIN$:IFLEN
    (IN$)<>4THENRETURN :rem 31
310 B$=IN$:GOSUB320:AD=A:B$=MI
    D$(IN$,3):GOSUB320:AD=AD*2
    56+A:RETURN        :rem 225
320 A=0:FOR J=1 TO 2:A$=MID$(B
    $,J,1):B=ASC(A$)-C4+(A$>"@
    ")*C7:A=A*C6+B     :rem 143
330 IF B<0 OR B>15 THEN AD=0:A
    =-1:J=2            :rem 132
340 NEXT:RETURN        :rem 240
350 B=INT(A/C6):PRINT MID$(H$,
    B+1,1);:B=A-B*C6:PRINT MID
    $(H$,B+1,1);:RETURN:rem 42
360 A=INT(AD/Z6):GOSUB350:A=AD
    -A*Z6:GOSUB350:PRINT":";
                       :rem 32
370 CK=INT(AD/Z6):CK=AD-Z4*CK+
    Z5*(CK>Z7):GOTO390:rem 131
380 CK=CK*Z2+Z5*(CK>Z7)+A
                       :rem 168
390 CK=CK+Z5*(CK>Z5):RETURN
                       :rem 159
400 PRINT"{DOWN}STARTING AT§4¾
    ";:GOSUB300:IF IN$<>N$ THE
    N GOSUB1030:IF F THEN400
                       :rem 75
410 RETURN             :rem 117
420 PRINT"{RVS} ENTER DATA ":G
    OSUB400:IF IN$=N$ THEN220
                       :rem 85
430 OPEN3,3:PRINT      :rem 34
440 POKE198,0:GOSUB360:IF F TH
    EN PRINT IN$:PRINT"{UP}
    {5 RIGHT}";        :rem 6
450 FOR I=0 TO 24 STEP 3:B$=S$
    :FOR J=1 TO 2:IF F THEN B$
    =MID$(IN$,I+J,1)   :rem 226
460 PRINT"{RVS}"B$L$;:IF I<24T
    HEN PRINT"{OFF}";  :rem 15
470 GET A$:IF A$=N$ THEN470
                       :rem 135
480 IF(A$>"/"ANDA$<":")OR(A$>"
    @"ANDA$<"G")THEN540
                       :rem 100
490 IF A$=R$ AND((I=0)AND(J=1)
    OR F)THEN PRINT B$;:J=2:NE
    XT:I=24:GOTO550    :rem 46
500 IF A$="{HOME}" THEN PRINT
    {SPACE}B$:J=2:NEXT:I=24:NE
    XT:F=0:GOTO440     :rem 66
510 IF(A$="{RIGHT}")ANDF THENP
    RINT B$L$;:GOTO540:rem 107
520 IF A$<>L$ AND A$<>D$ OR((I
    =0)AND(J=1))THEN GOSUB1060
    :GOTO470           :rem 232
530 A$=L$+S$+L$:PRINT B$L$;:J=
    2-J:IF J THEN PRINT L$;:I=
    I-3                :rem 12
540 PRINT A$;:NEXT J:PRINT S$;
                       :rem 2
550 NEXT I:PRINT:PRINT"{UP}
    {5 RIGHT}";:INPUT#3,IN$:IF
     IN$=N$ THEN CLOSE3:GOTO22
    0                  :rem 106
560 FOR I=1 TO 25 STEP3:B$=MID
    $(IN$,I):GOSUB320:IF I<25
    {SPACE}THEN GOSUB3B0:A(I/3
    )=A                :rem 81
570 NEXT:IF A<>CK THEN GOSUB10
    60:PRINT"{BLK}{RVS} ERROR:
     REENTER LINE §4¾":F=1:GOT
    O440               :rem 161
5B0 GOSUB1080:B=BS+AD-SA:FOR I
    =0 TO 7:POKE B+I,A(I):NEXT
                       :rem 245
590 AD=AD+B:IF AD>EA THEN CLOS
    E3:PRINT"{DOWN}{BLU}** END
     OF ENTRY **{BLK}{2 DOWN}"
    :GOTO700           :rem 207
600 F=0:GOTO440        :rem 84
610 PRINT"{CLR}{DOWN}{RVS} DIS
    PLAY DATA ":GOSUB400:IF IN
    $=N$ THEN220       :rem 146
620 PRINT"{DOWN}{BLU}PRESS:
    {RVS}SPACE{OFF} TO PAUSE,
    {SPACE}{RVS}RETURN{OFF} TO
     BREAK§4¾{DOWN}"   :rem 241
630 GOSUB360:B=BS+AD-SA:FORI=B
    TO B+7:A=PEEK(I):GOSUB350:
    GOSUB380:PRINT S$; :rem 56
640 NEXT:PRINT"{RVS}";:A=CK:GO
    SUB350:PRINT       :rem 144
650 F=1:AD=AD+B:IF AD>EA THENP
    RINT"{DOWN}{BLU}** END OF
    {SPACE}DATA **":GOTO220
                       :rem 170
660 GET A$:IF A$=R$ THEN GOSUB
    1080:GOTO220       :rem 65
670 IF A$=S$ THEN F=F+1:GOSUB1
    080                :rem 2B
6B0 ONFGOTO630,660,630:rem 224
```

```
690 PRINT"{DOWN}{RVS} LOAD DAT
    A ":OP=1:GOTO710    :rem 31
700 PRINT"{DOWN}{RVS} SAVE FIL
    E ":OP=0            :rem 32
710 IN$=N$:INPUT"{DOWN}FILENAM
    E{43}";IN$:IF IN$=N$ THEN22
    0                   :rem 229
720 F=0:PRINT"{DOWN}{BLK}{RVS}
    T{OFF}APE OR {RVS}D{OFF}IS
    K: {43}";           :rem 66
730 GET A$:IF A$="T"THEN PRINT
    "T{DOWN}":GOTO880   :rem 90
740 IF A$<>"D"THEN730   :rem 90
750 PRINT"D{DOWN}":OPEN15,8,15
    ,"I0:":B=EA-SA:IN$="0:"+IN
    $:IF OP THEN810     :rem 163
760 OPEN 1,8,8,IN$+",P,W":GOSU
    8860:IF A THEN220   :rem 66
770 AH=INT(SA/256):AL=SA-(AH*2
    56):PRINT#1,CHR$(AL);CHR$(
    AH);                :rem 221
780 FOR I=0 TO B:PRINT#1,CHR$(
    PEEK(BS+I));:IF ST THEN800
                        :rem 171
790 NEXT:CLOSE1:CLOSE15:GOTO94
    0                   :rem 230
800 GOSUB1060:PRINT"{DOWN}
    {BLK}ERROR DURING SAVE:{43}
    ":GOSUB860:GOTO220  :rem 61
810 OPEN 1,8,8,IN$+",P,R":GOSU
    B860:IF A THEN220   :rem 57
820 GET#1,A$,B$:AD=ASC(A$+Z$)+
    256*ASC(B$+Z$):IF AD<>SA T
    HEN F=1:GOTO850     :rem 155
830 FOR I=0 TO 8:GET#1,A$:POKE
     BS+I,ASC(A$+Z$):IF ST AND
    (I<>B)THEN F=2:AD=I:I=B
                        :rem 180
840 NEXT:IF ST<>64 THEN F=3
                        :rem 20
850 CLOSE1:CLOSE15:ON ABS(F>0)
    +1 GOTO960,970      :rem 12
860 INPUT#15,A,A$:IF A THEN CL
    OSE1:CLOSE15:GOSUB1060:PRI
    NT"{RVS}ERROR: "A$:rem 114
870 RETURN              :rem 127
880 POKE183,PEEK(FA+2):POKE187
    ,PEEK(FA+3):POKE188,PEEK(F
    A+4):IFOP=0THEN920:rem 178
890 SYS 63466:IF(PEEK(783)AND1
    )THEN GOSUB1060:PRINT"
    {DOWN}{RVS} FILE NOT FOUND
    ":GOTO690           :rem 34

900 AD=PEEK(829)+256*PEEK(830)
    :IF AD<>SA THEN F=1:GOTO97
    0                   :rem 201
910 A=PEEK(831)+256*PEEK(832)-
    1:F=F-2*(A<EA)-3*(A>EA):AD
    =A-AD:GOTO930       :rem 75
920 A=SA:B=EA+1:GOSUB1010:POKE
    780,3:SYS 63338     :rem 107
930 A=BS:B=BS+(EA-SA)+1:GOSUB1
    010:ON OP GOTO950:SYS 6359
    1                   :rem 38
940 GOSUB1080:PRINT"{BLU}** SA
    VE COMPLETED **":GOTO220
                        :rem 139
950 POKE147,0:SYS 63562:IF ST<
    >64 THEN970         :rem 39
960 GOSUB1080:PRINT"{BLU}** LO
    AD COMPLETED **":GOTO220
                        :rem 126
970 GOSUB1060:PRINT"{BLK}{RVS}
    ERROR DURING LOAD:{DOWN}
    {43}":ON F GOSUB980,990,100
    0:GOTO220           :rem 233
980 PRINT"INCORRECT STARTING A
    DDRESS (";:GOSUB360:PRINT"
    )":RETURN           :rem 145
990 PRINT"LOAD ENDED AT ";:AD=
    SA+AD:GOSUB360:PRINT D$:RE
    TURN                :rem 159
1000 PRINT"TRUNCATED AT ENDING
     ADDRESS":RETURN    :rem 166
1010 AH=INT(A/256):AL=A-(AH*25
     6):POKE193,AL:POKE194,AH
                        :rem 95
1020 AH=INT(B/256):AL=B-(AH*25
     6):POKE174,AL:POKE175,AH:
     RETURN             :rem 122
1030 IF AD<SA OR AD>EA THEN105
     0                  :rem 135
1040 IF(AD>511 AND AD<40960)OR
     (AD>49151 AND AD<53248)TH
     EN GOSUB1080:F=0:RETURN
                        :rem 104
1050 GOSUB1060:PRINT"{RVS} INV
     ALID ADDRESS {DOWN}{BLK}"
     :F=1:RETURN        :rem 224
1060 POKE SD+5,31:POKE SD+6,20
     8:POKE SD,240:POKE SD+1,4
     :POKE SD+4,33      :rem 19
1070 FOR S=1 TO 100:NEXT:GOTO1
     090                :rem 90
1080 POKE SD+5,8:POKE SD+6,240
     :POKE SD,0:POKE SD+1,90:P
     OKE SD+4,17        :rem 182
1090 FOR S=1 TO 100:NEXT:POKE
     {SPACE}SD+4,0:POKE SD,0:P
     OKE SD+1,0:RETURN  :rem 8
```

Program 2: MLX for Apple

Version by Tim Victor, Editorial Programmer

```
100 N = 9: HOME : NORMAL : PRIN
    T "APPLE MLX": POKE 34,2: O
    NERR  GOTO 610
110 VTAB 1: HTAB 20: PRINT "STA
    RT ADDRESS";: GOSUB 530: IF
     A = 0 THEN  PRINT  CHR$ (7
    ): GOTO 110
120 S = A
130 VTAB 2: HTAB 20: PRINT "END
     ADDRESS  ";: GOSUB 530: IF
     S  > = A OR A = 0 THEN  PR
    INT  CHR$ (7): GOTO 130
140 E = A
150 PRINT : PRINT "CHOOSE: (E)NT
    ER DATA";: HTAB 22: PRINT "
    (D)ISPLAY DATA": HTAB B: PR
    INT "(L)OAD FILE  (S)AVE FI
    LE  (Q)UIT": PRINT
160 GET A$: FOR I = 1 TO 5: IF
    A$ < > MID$ ("EOLSQ",I,1) T
    HEN  NEXT : GOTO 160
170 ON I GOTO 270,220,180,200:
    POKE 34,0: END
180 INPUT "FILENAME: ";A$: IF A
    $ <  > "" THEN  PRINT  CHR$
     (4);"BLOAD";A$;",A";S
190 GOTO 150
200 INPUT "FILENAME: ";A$: IF A
    $ <  > "" THEN  PRINT  CHR$
     (4);"BSAVE";A$;",A";S;",L"
    ;E - S
210 GOTO 150
220 GOSUB 590: IF B = 0 THEN 15
    0
230 FOR B = B TO E STEP B:L = 4
    :A = B: GOSUB 5B0: PRINT A$
    ;": ";:L = 2
240 FOR F = 0 TO 7:V(F + 1) = P
    EEK (B + F): NEXT : GOSUB 5
    60:V(9) = C
250 FOR F = 1 TO N:A = V(F): GO
    SUB 5B0: PRINT A$" ";: NEXT
     : PRINT : IF  PEEK (49152)
    < 128 THEN  NEXT
260 POKE 4916B,0: GOTO 150
270 GOSUB 590: IF B = 0 THEN 15
    0
2B0 FOR B = B TO E STEP B
290 HTAB 1:A = B:L = 4: GOSUB 5
    B0: PRINT A$;": ";: CALL 64
    66B:A$ = "":P = 0: GOSUB 33
    0: IF L = 0 THEN 150
300 GOSUB 470: IF F < > N THEN
    PRINT CHR$ (7);: GOTO 290
310 IF N = 9 THEN GOSUB 560: IF
     C < > V(9) THEN PRINT CHR$
     (7);: GOTO 290
320 FOR F = 1 TO B: POKE B + F
    - 1,V(F): NEXT : PRINT : NE
    XT : GOTO 150
330 IF LEN (A$) = 33 THEN A$ =
    O$:P = 0: PRINT CHR$ (7);
340 L = LEN (A$):O$ = A$:O = P:
    L$ = "": IF P > 0 THEN L$ =
     LEFT$ (A$,P)
350 R$ = "": IF P < L - 1 THEN
    R$ =  RIGHT$ (A$,L - P - 1)
360 HTAB 7: PRINT L$;: FLASH :
    IF P < L THEN PRINT MID$ (A
    $,P + 1,1);: NORMAL : PRINT
     R$;
370 PRINT " ";: NORMAL
3B0 K = PEEK (49152): IF K < 12
    B THEN 3B0
390 POKE 4916B,0:K = K - 12B
400 IF K = 13 THEN HTAB 7: PRIN
    T A$;" ";: RETURN
410 IF K = 32 OR K > 47 AND K <
     5B OR K > 64 AND K < 71 TH
    EN A$ = L$ + CHR$ (K) + R$:
    P = P + 1
420 IF K = 4 THEN A$ = L$ + R$
430 IF K = 9 THEN A$ = L$ + " "
     + MID$ (A$,P + 1,1) + R$
440 IF K = B THEN P = P - (P >
    0)
450 IF K = 21 THEN P = P + (P <
     L)
460 GOTO 330
470 F = 1:O = 0: FOR P = 1 TO L
    EN (A$):C$ = MID$ (A$,P,1):
     IF F > N AND C$ < > " " TH
    EN  RETURN
4B0 IF C$ < > " " THEN  GOSUB 5
    20:V(F) = J + 16 * (O = 1)
    * V(F):O = O + 1
490 IF O > 0 AND C$ = " " OR O
    = 2 THEN O = 0:F = F + 1
500 NEXT : IF O = 0 THEN F = F
    - 1
510 RETURN
520 J = ASC (C$):J = J - 4B - 7
    * (J > 64): RETURN
530 A = 0: INPUT A$:A$ = LEFT$
    (A$,4): IF LEN (A$) = 0 THE
    N RETURN
540 FOR P = 1 TO LEN (A$):C$ =
    MID$ (A$,P,1): IF C$ < "0"
    OR C$ > "9" AND C$ < "A" OR
     C$ > "Z" THEN A = 0: RETUR
    N
550 GOSUB 520:A = A * 16 + J: N
    EXT : RETURN
560 C = INT (B / 256):C = B - 2
    54 * C - 255 * (C > 127):C
    = C - 255 * (C > 255)
570 FOR F = 1 TO B:C = C * 2 -
    255 * (C > 127) + V(F):C =
    C - 255 * (C > 255): NEXT :
     RETURN
5B0 I = FRE (0):A$ = "": FOR I
    = 1 TO L:T =  INT (A / 16):
    A$ =  MID$ ("01234567B9ABCD
    EF",A - 16 * T + 1,1) + A$:
    A = T: NEXT : RETURN
590 PRINT "FROM ADDRESS";: GOS
    UB 530: IF S > A OR E < A O
    R A = 0 THEN B = 0: RETURN
600 B = S + B * INT ((A - S) /
    B): RETURN
610 PRINT "DISK ERROR": GOTO 15
    0                                ©
```

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1A. COMPUTE!
1B. 537250
2. 9-27-85
3. Monthly
3A. Twelve
3B. $24.00
4. 324 West Wendover Ave., Suite 200, Greensboro, NC 27408
5. Same
6. Publisher, James Casella, 825 Seventh Avenue, New York, NY 10019
Editor, Robert C. Lock, 324 W. Wendover Ave., Suite 200, Greensboro, NC 27408
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8. N/A
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10. Extent and Nature of Circulation

	Average no. of copies each issue during preceding 12 months	Actual no. copies of single issue published nearest to filing date
A. Total no. Copies (Net Press Run)	552,208	535,075
B. Paid Circulation		
1. Sales through dealers and carriers, street vendors, and counter sales	138,289	105,889
2. Mail subscriptions	210,410	247,404
C. Total Paid Circulation	348,699	353,293
D. Free Distribution by mail, carrier, or other means, samples, complimentary and other free copies	440	1,049
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1. Office use, left over, unaccounted for, spoiled after printing	18,453	7,232
2. Returns from news agents	184,616	173,501
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Advertisers Index

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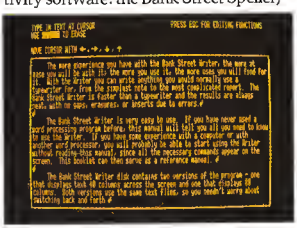

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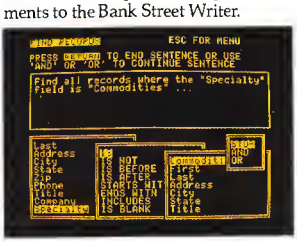

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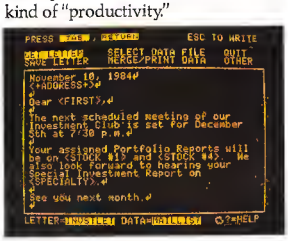

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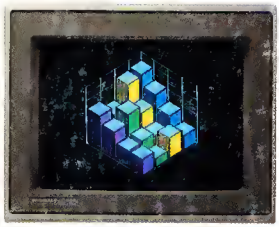
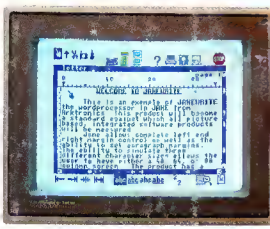
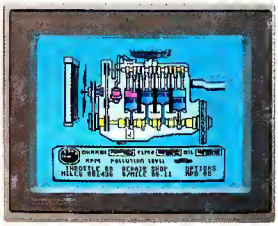


graph a spreadsheet



write a novel



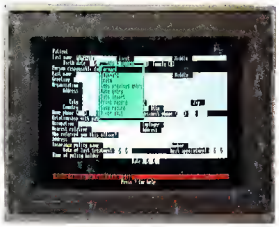
fix an engine

compose a song

paint a picture

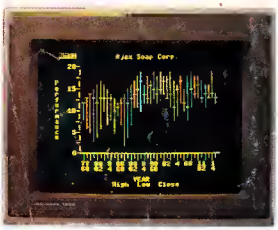
ur banking

learn ta fly



organize a data base

tell a story



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